New Scientist

WEEKLY March 25 - 31, 2023

VOLCANOES ON VENUS
Strong evidence of a recent eruption

COVID ORIGINS
Raccoon dog DNA offers fresh clues

THE VERY LONG VIEW
How to become a far-sighted thinker

WHY THE UNIVERSE IS JUST RIGHT FOR LIFE

Stephen Hawking's final theory tackles the biggest question of all



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Elsewhere on New Scientist

Virtual event

Fermilab: Solving the mysteries of matter and energy, space and time

Join Fermilab senior scientist Don Lincoln as he explains what the particle physics facility in Illinois has taught us about our universe. Major discoveries made at the lab include the top and bottom quarks – and its future work might be critical for a "theory of everything". Online on 4 April at 6pm BST/ 1pm EDT. Tickets are £16.

newscientist.com/events

Tour

Explore the science of London along the river Thames

Immerse yourself in London's scientific sites. Led by Blue Badge guides and accompanied by *New Scientist*'s Rowan Hooper, David Stock and Emily Wilson, you will visit sites including the London Wetland Centre and the Greenwich Observatory. The five-day tour begins on 2 July and costs £2165.

newscientist.com/tours

Podcast

Weekly

Podcast editor Rowan Hooper and the team hear about a living artificial intelligence built with brain organoids. There is also news of a cure for sickle cell disease. Plus, in a bonus episode, space reporter Leah Crane speaks to Erika Nesvold about her new book *Off-Earth: Ethical questions and quandaries for living in outer space*.

newscientist.com/nspod



ALEXANTON/SHUTTERSTOCK

Monumental mystery How were Egypt's ancient pyramids built?



DAVID REED/ALAMY

Wildlife in the city An otter at the London Wetland Centre

Video

Acrobatic physics

On our YouTube channel this week there is footage from *Cosmic Tumbles, Quantum Leaps*, a performance given by Le PeTiT CiRqUe, a Los Angeles-based company of contortionists, acrobats, aerialists and musicians. The show took place in Las Vegas this month, where the American Physical Society was holding a conference.

youtube.com/newscientist

Newsletter

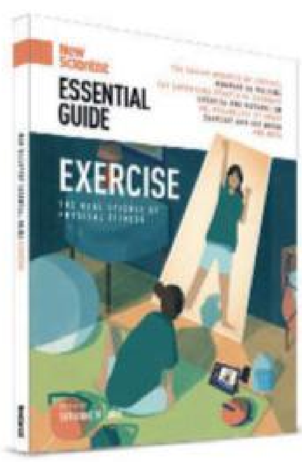
Our Human Story

How were ancient structures like Egypt's pyramids built? Practical archaeology offers some clues, writes Michael Marshall. The latest example saw two researchers carry an 85-kilogram log 25 kilometres in a day, showing how logs could have been carried to a site called Chaco Canyon in New Mexico.

newscientist.com/our-human-story

Podcast

"This cure for sickle cell disease is being called one of the greatest feats in modern history"



Essential guide

Exercise is the best medicine. It keeps our bodies and minds in prime condition and adds years to our lives. But why do so few of us get enough? This *New Scientist Essential Guide* offers some clues. Available to download in the *New Scientist* app or to purchase in print from our shop.

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Stephen Hawking's parting gift

The physicist's final theorem will inspire deep debate for years to come

THERE was no one quite like Stephen Hawking. His work on cosmology dealt with extremely arcane mathematics, yet he was, until his death in 2018, the most recognisable scientist in the world. He explored the deepest mysteries of the universe, but he also appeared on *The Simpsons*.

Hawking's most famous contribution concerns the nature of black holes. In the 1970s, he found a precise way to describe their boundary, or event horizon, in terms of thermodynamics – the theory describing the interplay between temperature, heat and energy transfer – which led him to predict that black holes can emit radiation. This flew in the face of the assumption that nothing could escape a black hole – and thus sparked decades of deep thought and debate, as physicists grappled with the implications. Today, many see this black hole conundrum as the most likely route to a more unified theory of physics.

Has Hawking done it again with his final theorem? It turns out that, later in life, he spent 20 years pondering the question of why, out of all the possibilities, the universe has the particular properties that make it so well suited for life to emerge. On page 38, we have a wonderfully intimate account of his insights and how he came to them, written by his close collaborator, physicist Thomas Hertog.

> "The gist of the idea is that the laws of physics 'evolved', shaped by the early universe"

The gist of the idea is that the laws of physics, rather than truths that transcend time, were forged in the big bang and "evolved" into their current form, shaped by the environment of the early universe. As Hertog explains, the proposal involves a host of eye-popping predictions, including the idea that causality can run backwards, time disappears at the big bang and the universe is a hologram.

Hawking's final theorem is difficult to get your head around, and could be harder still to test, but it may yet be a gift to cosmologists. He has once again set the cat among the pigeons with a bevy of ideas that challenge and inspire. And, once again, it is up to physicists to digest them to see if they will be as fruitful as his big breakthrough on black holes. ▮

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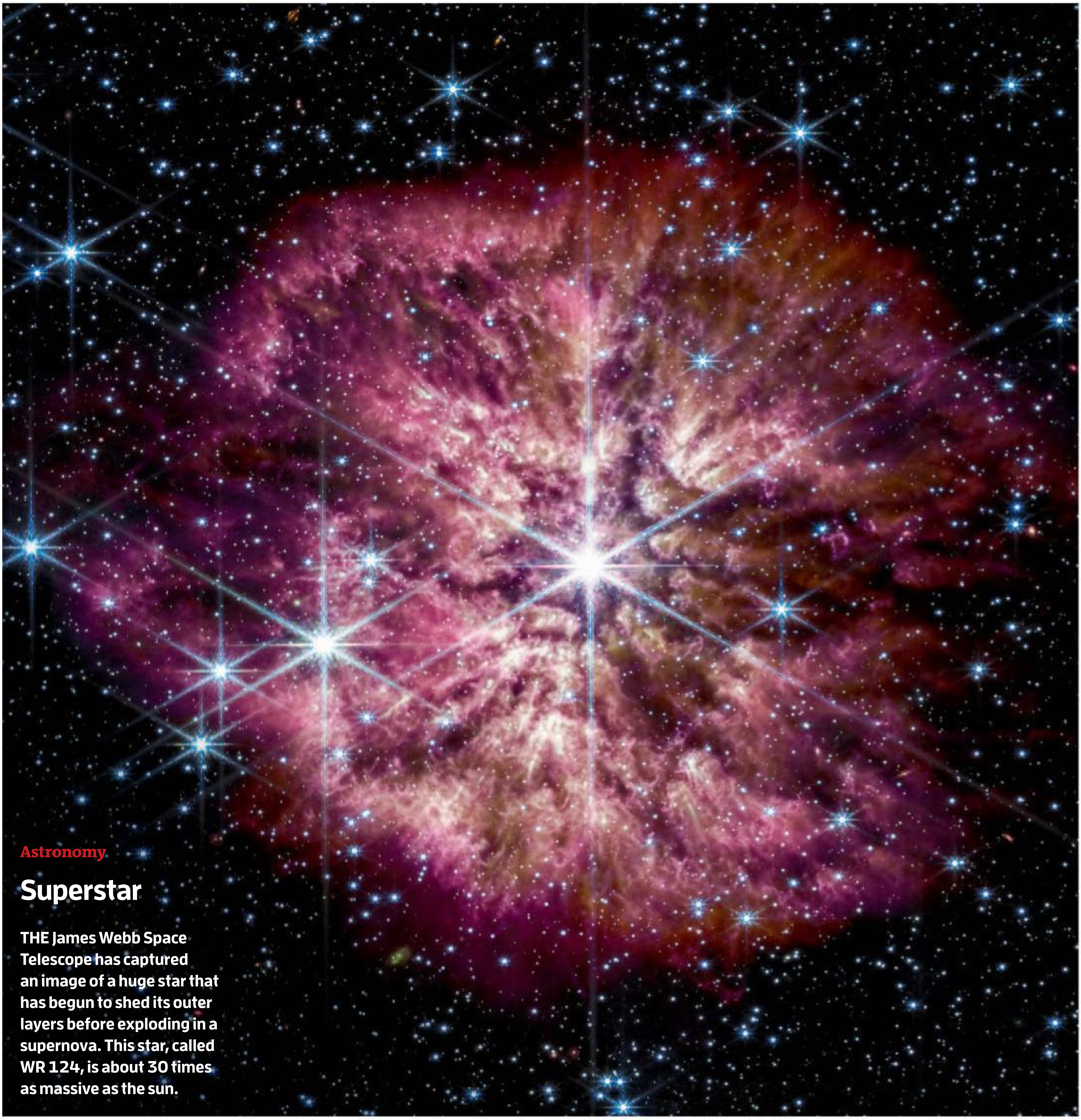
True or false
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Medieval marvel
Fire at Notre Dame revealed innovative engineering **p15**

HIV success
Woman in remission after stem cell transplant **p19**



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Astronomy

Superstar

THE James Webb Space Telescope has captured an image of a huge star that has begun to shed its outer layers before exploding in a supernova. This star, called WR 124, is about 30 times as massive as the sun.

Briefing Climate change

1.5°C climate goal is slipping away

The latest IPCC report reiterates that unless we take drastic action to cut emissions now, the world will miss its global warming target, explains **Michael Le Page**

THE Intergovernmental Panel on Climate Change (IPCC) has released its most recent report this week, yet again warning that without immediate and huge emissions reductions, we will fail to limit global warming to 1.5°C above pre-industrial temperatures. This is the goal set to try to avoid more severe planetary disruption.

"If we don't act with the necessary speed, we will shoot past 1.5 degrees and possibly even 2 degrees," says Peter Thorne at Maynooth University in Ireland, one of the authors of the report. "Really, it's a call to arms."

The world is now likely to reach 1.5°C in the first half of the next decade regardless of what happens with emissions, says Thorne, but what we do now determines whether we stabilise around that threshold or blast right through it.



LUKA GONZALES/AFP VIA GETTY IMAGES

Melting glaciers have swollen Lake Palcacocha in Peru, threatening to flood the nearby city of Huaraz

Does this mean the world is going to pass the 1.5°C limit?

Not necessarily, according to the authors of the report. Friederike Otto at Imperial College London says we already have all the technology needed to slash emissions. "It's clear what needs doing and we can do it," she says.

However, the scale of action now required is becoming ever more socially and politically unfeasible, even if it is still technically possible.

Cutting emissions to half of 1990 levels by 2030 would only give us a 50 per cent chance of staying at or below the 1.5 °C target, says Chris Jones at the UK's Met Office, another of the authors of the so-called synthesis report.

"[The latest] report reveals the sheer scale of the ambition required to avoid the worst consequences of climate change," says Jones. "Current policies are not on track."

Can we cool the world down again if we pass 1.5°C?

In theory, even if the world passes the 1.5°C mark in the coming decades, removing huge quantities of carbon dioxide from the atmosphere could cool the planet to 1.5°C by 2100, but we don't yet have the technology.

1.1°C

Amount the world has already warmed since pre-industrial times

"It is not currently considered possible to withdraw the volume of carbon dioxide needed to achieve that from the atmosphere," Camilla Mathison at the Met Office said in a statement.

That sounds bad…

Indeed. The warming so far is already contributing to ever more extreme events – such as record-smashing heatwaves last year – and causing widespread damage and losses. The impacts will continue to worsen with every bit of extra warming, the IPCC report warns. Some of the consequences may not be reversible even if we do manage to remove enough CO_2 to cool the planet later this century.

"This synthesis shows just how much the 1.1 degrees [of warming] so far is adversely affecting human and natural systems – that means, is killing people and destroying their livelihoods," says Otto.

The report also shows the inequity of climate change, she says. "Those causing the problems are not the ones suffering the consequences."

What should we be doing?

The report says the solution is climate-resilient development – taking measures to adapt to a warmer world alongside cutting greenhouse gas emissions. This would have wider benefits, says IPCC chair Hoesung Lee.

"Climate impacts are undermining our livelihoods. They are damaging the global economy and threaten our life-support system, nature itself," says Lee. "But the report also emphasises that effective and equitable climate action now can lead to a more sustainable, resilient and just world. More ambitious action will provide wider benefits for nature and people."

Hold on, what is the IPCC again?

The IPCC, a global group of climate researchers, was set up by the UN in 1988 to review the science on climate change and how to limit it. It has done six rounds of reports since then, and this report is the last part of that sixth round.

The IPCC's output is all based on previously published scientific studies. But some of those studies are done specifically for the IPCC, and the scientists who write the reports do come up with consensus estimates for things, such as how much warming there will be for a certain level of emissions. If anything, those estimates tend to be conservative; for instance, early IPCC reports were criticised for understating future sea level rise. There is also political wrangling over how strong the final wording is.

Political wrangling? I thought scientists write the IPCC reports?

Yes, hundreds of scientists work unpaid to review thousands of published studies and write the reports. But when it comes to the summaries for policy-makers – the only parts most journalists and commentators read – the wording of every sentence is argued over by representatives from UN member states. Some major fossil fuel-producing countries try to tone down the wording.

Coronavirus

Covid-19 may have first jumped to people via raccoon dogs

Clare Wilson

THE long-running debate over the origins of covid-19 has taken another turn. A French scientist has spotted genetic sequences that were put on a database by researchers in China that suggest the coronavirus behind the pandemic might have jumped to people from animals such as raccoon dogs at the Huanan Seafood Market in Wuhan, China.

Within a few days, the sequences were removed by the same researchers – although Florence Débarre at the French National Centre for Scientific Research managed to download them beforehand and is investigating further.

"It is critical that all data that relates to how this pandemic began be made available immediately"

"It is really critical that any and all data that relates to how this pandemic began be made available immediately," Maria Van Kerkhove at the World Health Organization (WHO) said at a press conference on 17 March. "There are several hypotheses that need to be examined, including how the virus entered the human population, either from a bat, through an intermediate host or through a breach in biosecurity from a lab. And we don't have a definitive answer."

The Huanan market has long been seen as a probable origin for the SARS-CoV-2 coronavirus, as many of the first cases of covid-19, in December 2019, were in people with a connection to it and the stalls sold a range of live and dead animals, not just seafood.

SARS-CoV-2's original host is thought to be bats, as they carry many coronaviruses. However, they haven't yet been found with SARS-CoV-2. The ancestor of this virus may have jumped from bats to an intermediate host sold at the market, and then to people.

Virus origin

An alternative explanation is that the virus escaped from the Wuhan Institute of Virology, where researchers were known to be studying bat coronaviruses, but not SARS-CoV-2. While this is a less-favoured idea among scientists, in February, the US Department of Energy said it was the most likely explanation, although it didn't release any supporting evidence.

Now, genetic sequences uploaded onto a global virology database called GISAID by the Chinese Center for Disease Control and Prevention may have shed more light on SARS-CoV-2's origin. These sequences were derived from swabs taken from various surfaces, such as stalls and wastewater collection sites, at the market in early 2020 after it had been shut down. They may have been uploaded some time ago.



ANAGRAMM/ISTOCKPHOTO/GETTY IMAGES

Raccoon dogs are susceptible to the SARS-CoV-2 coronavirus

The sequences were noticed by Débarre, who shared her findings with the WHO in mid-March. "I was focusing on market sequences when I logged in, but I was not expecting to find the data I found," she says.

Débarre declined to say any more until her analysis is complete, but Van Kerkhove said at the press conference: "Amongst the samples that were positive for SARS-CoV-2, they saw evidence of DNA of animals. Some of these animals include raccoon dogs."

Raccoon dogs (*Nyctereutes procyonoides*) have previously been found to be susceptible to SARS-CoV-2 and to be capable of spreading it. "We know they are good at carrying it," says Alice Hughes at the University of Hong Kong.

This doesn't prove that raccoon dogs or any of the other animals at the market were infected with the virus at the end of 2019 and such evidence is now impossible to source, says Hughes.

Jonathan Stoye at the Francis Crick Institute in London says: "The data would appear to provide convincing evidence that raccoon dogs and other animals were present at the market at a critical time. This is another link in the chain that you would expect to see if the pandemic started that way."

Off the back of the information Débarre shared, Van Kerkhove said the WHO has asked the Chinese Center for Disease Control and Prevention to rerelease the genetic data. "The big issue is that this data exists and that it is not readily available to the international community, not to mention that it should have been made available years earlier," she said.

At the same press conference, the WHO said that covid-19 will probably be downgraded from a public health emergency of international concern in 2023.

"We're coming to that point where we can look at covid-19 in the same way we look at seasonal influenza," said Michael Ryan at the WHO. "A threat to health, a virus that will continue to kill, but a virus that is not disrupting our society or disrupting our hospital systems."



ROMAN PILIPEY/EPA-EFE/SHUTTERSTOCK

Covid-19 probably emerged at this market in Wuhan, China

Psychology

The best way to spot a liar is to focus on the details of what they say

Carissa Wong

AN INVESTIGATION into the best way to identify lies has found that focusing on the level of detail in what people say, while ignoring all other cues, is the most successful method.

People trained to detect lies often rely on multiple signs, such as eye contact, length of responses and the details in what people say, but studies have shown that assessing a wide range of behavioural information can make it harder to decide if someone is lying. Bruno Verschuere at the University of Amsterdam and his colleagues wondered whether solely focusing on the detail of statements could provide more consistent results.

To test this idea, the researchers asked 44 students to either go for a walk or steal from a postbox in a mock crime. The team then conducted recorded interviews with the students, who were instructed to lie if they had committed the fake theft or to tell the truth if not.

Next, the researchers recruited 171 people to watch six truthful and six deceptive interviews from these recordings. The team asked around half of the participants to rate how much the interviewees averted their eyes, which is widely believed to indicate when someone is lying. The other participants ranked the level of detail in interview statements.

This revealed that both truth-tellers and liars averted their gaze a similar amount, but truthful statements were substantially more detailed than deceptive ones, suggesting the latter is a more useful way to tell that someone is lying.

The researchers then asked 405 people to judge the true nature of six truthful and six deceptive statements randomly chosen from transcripts of the interviews.

Around half of the participants used multiple cues to identify liars. The remaining participants solely ranked the level of detail in answers on a scale of 1 to 10, with a 6 or above counting as truthful.

The people relying on multiple cues accurately distinguished lies from the truth just 59 per cent of the time, while those relying on level of detail alone fared better, identifying the right answer 66 per cent of the time (*Nature Human Behaviour*, DOI: 10.1038/s41562-023-01556-2).

"Our take is that using just one cue can provide a much simpler way to judge lies from the truth," says Verschuere. Nevertheless, in the real world, you would probably want to verify the veracity of statements through further investigations or follow-up questions, he says.

But if someone knows you are only using the level of detail to assess their veracity, they could easily trick you, says Aldert Vrij at the University of Portsmouth, UK. "All the interviewee has to do to be believed is to provide a lot of information."

However, that comes with its own problems, says Verschuere. "The more detail you give, the more there is to be checked, so you take a big risk if you try to make up details."



Can you always take what people say at face value?

WESTEND61 GMBH/ALAMY

Astrobiology

Quantum physics might be key to life on Titan

CHEMICAL reactions crucial for life could be possible on Saturn's icy moon Titan thanks to a quantum effect called quantum tunnelling.

Titan is the only place other than Earth where liquid oceans and lakes have been observed on the surface – although the liquid in question there is ethane and methane, not water, but it is nevertheless intriguing for the possibility of life. The planet is also known to have complex molecules that make life, or at least the prebiotic chemistry that can lead to life, even more plausible.

But many reactions require a certain level of warmth, and the average temperature on Titan's surface is about −179°C (−290°F). Richard Remsing at Rutgers University in New Jersey and his colleagues performed simulations of chemistry in Titan-like conditions to try to figure out whether quantum effects could alleviate the problem.

Chemical reactions, such as transferring a proton or electron from one molecule to another, generally need some energy added to set them in motion. It is like rolling a ball from one valley into the next – the ball needs a boost to get over the hill between the two. At low temperatures, there isn't enough energy in the environment to push the reaction over that barrier.

That doesn't mean the barrier is impassable, though. Remsing and his colleagues found that it could be overcome through a phenomenon called quantum tunnelling, in which a particle passes straight through a barrier that it doesn't have the energy to surmount. The team presented the work on 15 March at the Lunar and Planetary Science Conference in Houston, Texas.

"Lots of people think it's too cold on the surface of Titan, nothing's going to happen chemically – but if the particles can tunnel through that energy barrier, it could," says Remsing. "If you are going to be having prebiotic chemistry in this environment, this might be the only way to have reactions."

"Titan is the only place other than Earth where liquid oceans have been observed on the surface"

Leah Crane

Astrophysics

Some asteroids may be 'dark comets' with invisible tails

Jonathan O'Callaghan

CERTAIN small objects in space seem to fire jets of gas that can't be seen with telescopes, suggesting they should be classed in a new category between asteroids and comets.

Comets periodically emit bursts of gas and dust as they approach the sun, which melts their icy surfaces. These events give off as much as 10 kilograms of dust per second, which reflects sunlight and makes the bursts visible, often creating a tail behind the comet. Asteroids, being rockier, don't produce such bursts.

However, Davide Farnocchia at NASA's Jet Propulsion Laboratory in California and his colleagues think they have found a handful of objects that look like asteroids at first glance, but also produce jets. As they orbit the sun, the objects were seen to periodically undergo jumps of speed that couldn't be attributed to other factors. "There was a clear acceleration," says Farnocchia.

It is thought that the objects, which are mostly no more than a few tens of metres across, were firing out comet-like jets but with much lower dust rates, perhaps only about 100 micrograms per second. As such, the jets are invisible to telescopes and are only detectable by the acceleration they cause to the objects. The team dub the objects "dark comets" (*The Planetary Science Journal*, doi.org/j3nw).

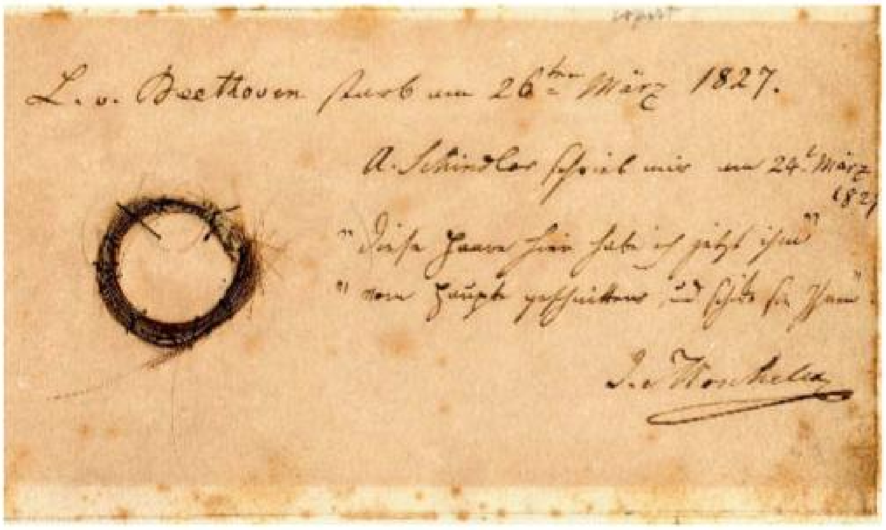
"The reason we haven't found these before is they're very small objects and we needed a lot of observations for these accelerations to become significant," says Aster Taylor at the University of Chicago, who was part of the study team. "You have to give it months to years to see the acceleration."

Alan Fitzsimmons at Queen's University Belfast, UK, says the results are "potentially really interesting", hinting at a class of inert comets that had gone undetected before. ▮

Genetics

Beethoven's genome hints that he died from liver damage

Jason Arunn Murugesu



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BEETHOVEN HAUS BONN

Left: A lock of Beethoven's hair. Right: His portrait

GENETIC analysis of Ludwig van Beethoven's hair has revealed that the composer had a high genetic risk for liver disease, which could have contributed to his death. It has also overturned a previous idea about him having had lead poisoning, but uncovered no explanation for why he lost his hearing.

Tristan Begg at the University of Cambridge and his colleagues have analysed the DNA of eight locks of hair purported to come from Beethoven's head to see if it could explain the composer's health issues.

Beethoven, born in 1770, started losing his hearing in his mid-20s, as he started to grow in fame. He was almost completely deaf by his mid-40s and experienced severe gastrointestinal issues during his life. He died in 1827, aged 56. A post-mortem examination at the time revealed that he had severe liver damage.

The researchers' first task was making sure the hair actually came from Beethoven. Locks of hair were a typical memento in the Victorian era, says Begg, and there are dozens of locks purported to be Beethoven's around the world.

They therefore examined the paperwork for each lock and used DNA analysis to determine the age of the samples. "For DNA samples from the last few centuries, you'll tend to see the accumulation of damage patterns," says Begg. "You want to see these patterns consistent with the documented age of the samples."

Then they compared the DNA of the eight locks. The combination of these methods led them to conclude that five of them were from Beethoven. "I think we are able to authenticate these five locks of hair with great confidence," says Begg.

"There are dozens of locks of hair purported to be Beethoven's around the world"

Examining the DNA data, the researchers found that the composer had a high genetic risk for liver disease. Begg says this risk would be relatively benign for most people, but Beethoven's reportedly high alcohol consumption would have increased the likelihood that he developed the condition. Begg says this finding, combined with the autopsy report, suggests that cirrhosis of the liver, caused by liver disease, could have led to Beethoven's death (*Current Biology*, DOI: 10.1016/j.cub.2023.02.041).

The team also found evidence that Beethoven had a hepatitis B infection in the best-preserved lock of hair, which is likely to have been cut off near the end of his life. This virus can also cause liver damage.

But the researchers found no genetic factor linked to the composer's gastrointestinal problems or deafness. Begg isn't surprised when it comes to the latter. "Late-onset forms of hearing loss are rarely caused by a single gene," he says.

"This kind of genetic study of a famous individual is fascinating," says Layla Renshaw at Kingston University, UK, and it satisfies a similar curiosity to reading their letters or diaries.

Previous attempts to sequence Beethoven's DNA from hair samples suggested he had lead poisoning, but this study reveals that the earlier work was done on hair from a woman. "Given this background, there is a good case ethically for using genetic analysis to dispel previous misconceptions or speculation," says Renshaw. ▮

Materials

Superconductor discovery called into question

Alex Wilkins

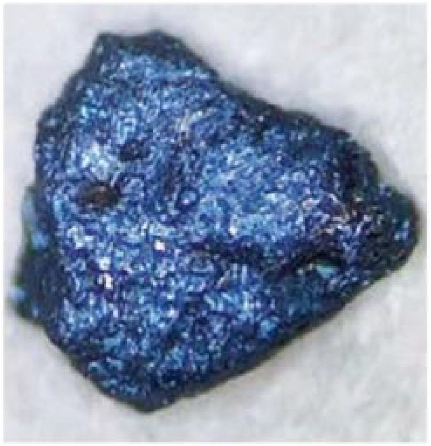
RED matter, a material that researchers claimed showed evidence of being a room-temperature superconductor with the promise of revolutionising electronics, might not be so super after all, after another group struggled to replicate the results.

Earlier this month, Ranga Dias at the University of Rochester in New York and his colleagues said they had created a superconducting material – one that allows electricity to flow with zero resistance – that they called red matter to reflect its colour change under pressure (*New Scientist*, 18 March, p 9). All other known superconductors require impractical temperatures and pressures, but the team said that red matter works at just 21°C (69°F) and a pressure of 1 gigapascal.

Now, Hai-Hu Wen at Nanjing University in China and his colleagues say they have used the same ingredients of hydrogen, nitrogen and lutetium to create a sample with the same structure, but it lacks any superconducting properties (arXiv, doi.org/j3hz). "No trace of superconductivity can be found," says Wen.

> "This work can't be done easily or quickly by anyone, it takes incredible patience"

In terms of the raw data, the two samples showed very similar readings, says Wen, so the different conclusions come down to how you interpret that data. Wen says that Dias's group unnecessarily subtracted background noise from the raw data to find superconductivity, a point also made by other critics of the work.


NANJING UNIVERSITY

An attempt to replicate red matter (which is blue at low pressures)

"We find it difficult to assume this group accurately recreated our material," says Dias, noting that Wen's material doesn't show the distinctive colour change under pressure that gives red matter its name. "This is conclusive evidence that they are not testing our sample."

Questions around red matter are heightened because of previous accusations of unconventional data techniques levelled at Dias and his colleagues. In 2022, *Nature* retracted a 2020 paper from Dias that claimed room-temperature superconductivity in a different compound. The authors all disagreed with the retraction, saying their data supported the paper's claims. *Physical Review Letters* has also announced it is reviewing one of Dias's papers due to claims of plagiarism. Dias denies the allegations.

Because of this, the publication of the red matter paper was greeted cautiously, with researchers hoping it would be replicated soon. But when Wen and his team tried to follow the recipe set out by Dias's team, they found it impossible to react lutetium with hydrogen and nitrogen gas at the suggested temperature of –208.15°C. Instead, they used their own method, mixing lutetium with calcium hydride and ammonia at 300°C, which gave off the required nitrogen and hydrogen to mix with the lutetium.

To check they had made red matter, Wen and his team used X-ray diffraction to determine its crystal structure. "The structure is exactly the same, the only unknown thing is the concentration of nitrogen," says Wen. "Maybe their sample is lower, ours is a bit higher."

But Dias's sample seems to contain a mixture of different structures of material and X-ray diffraction can't always tell the difference between similar structures, says Lilia Boeri at the University of Rome in Italy.

The difference in colour change under pressure also might indicate that the two materials don't have identical compositions, says Tim Strobel at the Carnegie Institution for Science in Washington DC. Strobel and his team are currently trying to reproduce the work of both groups to validate the findings, and say they will have results soon.

Dias says that replication will take time and couldn't have been achieved in the week that elapsed between his team's publication and that of Wen's group. "This work can't be done easily or quickly by anyone, it takes specialised technique, advanced lab work and incredible patience," he says. "Any group working to replicate our results should expect to be challenged, and multiple failed experiments are also likely, if our experience is any guide." ■

Space flight

NASA unveils new spacesuit for moon mission astronauts

Alex Wilkins

NASA has revealed the spacesuits that astronauts will wear on the moon for the upcoming Artemis missions, which will see the first woman and person of colour reach the lunar surface.

"We have not had a new suit since the suits that we designed for the space shuttle, and those suits are currently in use on the space station – so, for 40 years, we've been using the same suit based on that technology," said Vanessa Wyche at NASA's Johnson Space Center in Houston, Texas, at a press conference on 15 March.

The new suit, built by private firm Axiom Space for NASA, is designed to withstand the harsh environment of the lunar south pole, where temperatures are around -13°C (9°F) on average, but can dip hundreds of degrees lower in craters that are in permanent shadow.

It will have improved mobility over previous suits, weighing 55 kilograms – around 25kg lighter than those worn by the Apollo astronauts – and will have more custom joints for a greater range of motion. As the suit has so many joints, it can't be taken on and off easily. Astronauts will need to climb through a hatch at the back of the suit to enter.

It also has a panel of torches above the helmet for working in low light, plus a high-definition camera so people on Earth can watch what the astronauts are doing.

If all goes according to schedule, NASA's Artemis 3 mission will land the first woman and person of colour on the moon in 2025. ■


AXIOM SPACE

Axiom Space showed off a black version of its spacesuit, but white ones will be used on the moon

Viruses

Bird flu infects mammals' brains

H5N1 virus may be causing neurological symptoms in foxes and other animals

Michael Le Page

BIRD flu may be making wild mammals such as foxes and raccoons behave in unusual ways, according to a study of infections in the US. Out of 57 live mammals found to be infected, 53 had neurological symptoms, such as seizures, problems with balance, tremors and a lack of fear of people.

The risk to people appears to be low. "There isn't yet any evidence that red foxes or other wild mammals that have avian influenza could spread that infection to humans," says Betsy Elsmo at the University of Wisconsin-Madison.

But this doesn't mean it cannot happen, says Elsmo. "Humans should never interact with animals, particularly carnivores, that are behaving abnormally for multiple reasons, rabies of course being one."

Her team has reported 67 wild mammals in the US confirmed to be infected with H5N1 bird flu between 1 April and 22 July 2022. They include 50 red foxes (*Vulpes vulpes*), six striped skunks (*Mephitis mephitis*), four raccoons (*Procyon lotor*), two bobcats (*Lynx rufus*) and two Virginia opossums (*Didelphis virginiana*).

Ten of these animals were discovered dead, but the rest were found ill and either taken to wildlife rehabilitation centres or collected by wildlife professionals. Two of the foxes recovered, but the rest of the animals died or were euthanised. Post-mortems revealed brain damage in 51 out of 54 brains examined, and the bird flu virus was detected in many samples of brain tissue (bioRxiv, doi.org/j3jr).

Red foxes in the US have been found to have bird flu infections


GAERTNER/ALAMY

There have been previous reports of bird flu causing neurological symptoms in infected mammals. Elsmo thinks the relatively high number of brain infections found by her team isn't something specific to the virus strain that is currently circulating around the world, but is simply because this virus is so widespread.

"This new strain of avian influenza is much more widespread in wild birds than previous strains have been," says Elsmo. "There are increased opportunities, then, for wild mammals to interact with dead and dying birds."

Meanwhile, Debby van Riel at Erasmus University Medical Center in Rotterdam, the Netherlands, and her colleagues have found that H5N1 bird flu can infect the brain in ferrets via nerves in the nose, even if there is no respiratory infection (*PLoS Pathogens*, doi.org/j3jq).

"The virus could enter the nose by sniffing, but I think it is more likely that when mammals eat infected birds, aerosols are generated which end up in the nose," says van Riel.

"I would advise people to not have contact with sick birds or mammals, especially when they have respiratory or neurological signs including unusual behaviour," she says. "The risk of transmission is low, but I would not take the risk and would report any sick or dead mammal to the appropriate agencies." ▮

Earth

Earliest evidence of meteorite impact is 3.48 billion years old

THE oldest evidence of a meteorite hitting Earth has been found in Western Australia, inside a group of sedimentary and volcanic rocks called the Dresser Formation.

It is difficult to find and date old rocks on Earth because the constant geological and biological activity wears down the planet's crust. "If we go back about 3.5 billion years, there is only a very, very small percentage of the Earth's crust that is of that age," said Christian Köberl at the University of Vienna in Austria during a presentation at the Lunar and Planetary Science Conference in Houston, Texas, on 14 March.

Despite this, Köberl and his colleagues have now found evidence of a meteorite impact that occurred 3.48 billion years ago, making it the oldest such evidence on Earth. Two impact deposits in Australia and South Africa, from 3.47 billion and 3.45 billion years ago, were previously the oldest.

The new evidence came in the form of tiny spherules of rock, each less than a millimetre across, found in layers across a series of drill cores taken in Australia. Spherules form in a few different ways, but one is when a meteorite hits the ground and creates a splash of melted rock, which solidifies into tiny droplets.

To determine whether these particular spherules came from a meteorite impact, Köberl and his colleagues used a series of cutting-edge techniques to analyse their textures and chemical compositions. "Extraterrestrial components dominate the composition of these spherule layers," he said.

"The new evidence came in the form of tiny spherules of rock, each less than a millimetre across"

Those components include high amounts of iridium, some isotopes of osmium and minerals called nickel-chromium spinels. They also had characteristic dumbbell and teardrop shapes and bubbles inside them, common in impact spherules due to how they solidify after the meteorite strike. These newfound grains are nearly identical to the slightly younger ones researchers found in Australia and South Africa. ▮

Leah Crane

Technology

Quantum computers may have found a practical use

Alex Wilkins

QUANTUM computers can be used to generate truly random numbers that can't be faked. This could be a boost to the likes of secure communication and cryptocurrencies.

The process could be run on today's best quantum systems, such as Google's Sycamore processor, and would be the first truly practical task that would be impossible without a quantum machine, say the researchers involved.

Random numbers are used in cybersecurity, including for secure messaging and password creation, and for verifying some cryptocurrency transactions, but producing random numbers you can trust is hard. If someone knows how the algorithm creating the numbers works, then they can be predicted, making them nonrandom and the system unsafe.

In 2013, for example, leaks by Edward Snowden revealed that the US government had installed a backdoor in a random number generator made by the US National Institute of Standards and Technology, so that its numbers could be predicted.

The upshot is that all random number generators in use today are pseudorandom: they are so hard to predict that their output seems random. But attacks are possible. A number generator that gives a truly random result, however, would be invulnerable.

Many people have looked to quantum mechanics as a source of random numbers, because quantum processes happen according to probabilistic rules, and so it is impossible to reliably predict the outcome of a single process. A problem with this, however, is that there is no way of verifying whether a number is genuine if you weren't there to see the process.

Now, Scott Aaronson and Shih-Han Hung at the University of Texas at Austin have developed a protocol that can certify such numbers without this requirement. It involves asking a quantum computer to complete a test

"The huge advantage with this proposal is that you can do it with existing devices"

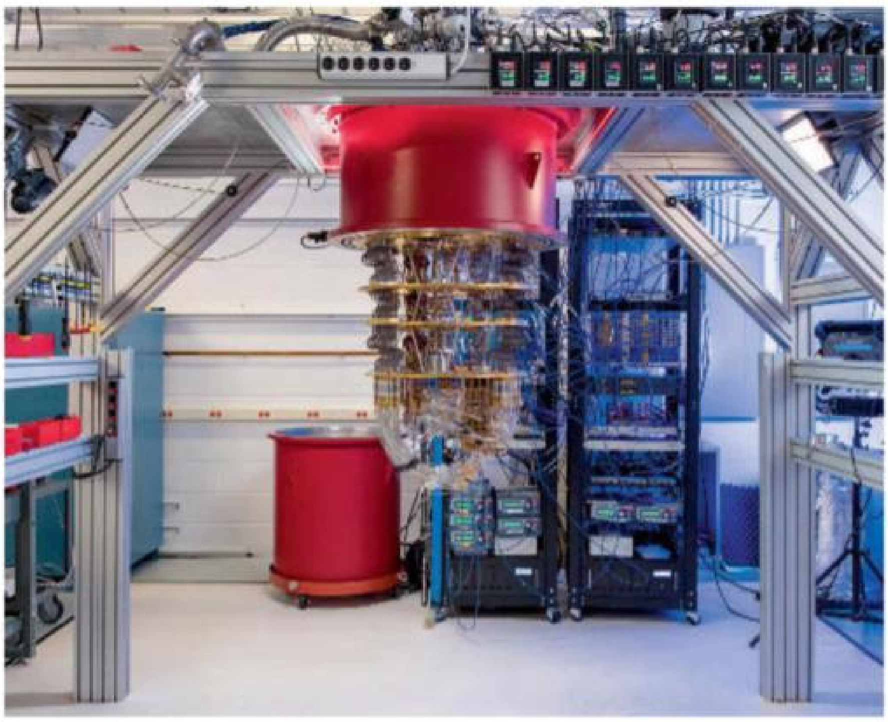
in a set amount of time that only it can pass. "The only way for a quantum computer to pass the test is to do the quantum computation that it's supposed to do, or something similar to it," says Aaronson.

This test involves running a series of pseudorandom operations on quantum bits, or qubits, measuring the outputs – which serve as the truly random numbers – and trying to simulate those outputs on a classical computer. If the latter can't do it, then the outputs of the quantum computer must be from quantum processes and be truly random (arxiv.org/abs/2303.01625).

As long as the quantum computer can solve certain problems faster than the best classical computers, a capability known as quantum supremacy, the method could work on current quantum machines. "The huge advantage with this proposal is that you can actually do it with devices that currently exist," says Aaronson.

It is an impressive piece of work, says Carlos Perez-Delgado at the University of Kent, UK, and is the only workable method for verifying true randomness without having to witness the process involved.

Some people might claim the process is overkill, though, says Perez-Delgado. "For pretty much any application, you don't need to prove that a sequence of numbers is random in the deep sense that the universe considers them random." ▮



HANNAH BENET/GOOGLE

Google's quantum computer could create truly random numbers

Geology

Earth's early oxygen may be a result of earthquakes

James Dinneen

EARTHQUAKES may have enabled oxygen-producing reactions that shaped the evolution of some of Earth's earliest organisms.

There was very little oxygen in Earth's atmosphere until levels spiked during the Great Oxidation Event between 2.4 billion and 2.3 billion years ago, thanks to the rapid spread of microbes that release oxygen through photosynthesis. However, the widespread presence of antioxidant enzymes across the tree of life suggests a common ancestor that existed prior to this event was exposed to some amount of oxygen.

Mark Thiemens at the University of California, San Diego, and his colleagues ground up quartz rock and exposed it to water under chemical conditions similar to those on early Earth. The researchers used quartz because it is the simplest and most common silicate mineral.

They found that broken crystals on the surface of quartz can react with water to form molecular oxygen and reactive oxygen species, such as hydrogen peroxide. Also known as free radicals, these would have been critical to early evolution, says Timothy Lyons at the University of California, Riverside.

In nature, quartz and other silicate minerals could be abraded by earthquakes, erosion or moving ice. They could then interact with water to produce those same molecules. The team estimated that seismic processes alone could have generated 100 billion times more hydrogen peroxide than atmospheric reactions, another possible source of abiotic oxygen (*PNAS*, doi.org/j3kw).

Adaptations to this seismic source of oxygen may have helped some organisms survive the radical shift in Earth's chemistry that accompanied the Great Oxidation Event hundreds of millions of years later, says Lyons. ▮

Architecture

Notre Dame's innovative use of iron

The 2019 fire at the cathedral has revealed how metal staples were used as reinforcements

Jeremy Hsu

WHEN a fire destroyed the Notre Dame Cathedral's famous spire and most of its roof in 2019, the immediate damage and subsequent renovation efforts unexpectedly revealed large iron staples holding together many of the building's stone blocks. Analysis has now shown that Notre Dame was the first Gothic cathedral to use such iron reinforcement throughout its structure – a fact that highlights the iconic building as a high-tech, modern marvel of its time.

"You realise they were doing things that were like the Empire State Building around 1930, or like the Burj Khalifa in Dubai – really extraordinary stuff for the time," says Robert Bork at the University of Iowa, who wasn't involved in the analysis. "You can compare it to the moonshot in the 1960s."

Notre Dame was the tallest building ever constructed when the project first began in medieval Paris during the 1160s. Examination of the cathedral during its ongoing renovation has allowed Maxime L'Héritier at Paris 8 University Vincennes-Saint-Denis in France and his colleagues to estimate that the building has thousands of staples from the floors to the upper walls.



MIKHAIL PAVLOV/ALAMY

The Notre Dame Cathedral in Paris is still being restored after a 2019 fire

"The fact that the framework burned made some staples that could not be visible before appear to us," says L'Héritier. Each staple is about 50 centimetres long and weighs between 2 and 4 kilograms. Radiocarbon dating of 12 staples showed that they were used in the earliest stages of the cathedral's construction (*PLoS One*, doi.org/grxh2h).

The use of iron to reinforce the building's stones and other features – such as the stained glass windows' iron connections – was key in creating the cathedral's Gothic style of architecture, says Bork. Unlike the blockier stone architecture of Roman times, medieval builders of Gothic architecture took advantage of such iron innovation to create structures that appear lighter and much more detailed.

"This study confirms that use of iron made this lighter structure at Paris possible and thus the use of this material was crucial to the design of the first Gothic architect of Notre Dame," says Jennifer Feltman at the University of Alabama, who wasn't involved in the work.

"The use of iron to reinforce the building's stones was key in creating the cathedral's Gothic style"

Analysis of the iron staples' current strength will provide modern architects with information on how to reuse undamaged iron staples in rebuilding the Notre Dame Cathedral to its former glory. "Now it's not diagnosis time – it's restoration time," says L'Héritier. ■

Biology

How poisonous amphibians evolved warning colours

THE mystery of how animals evolve vivid colours to warn predators they are poisonous or taste nasty appears to have been solved, for amphibians at least.

Some animals, including many species of frog and insect, have conspicuous colours and patterns to warn predators that they taste horrible or are poisonous. This approach protects most of them because inexperienced predators learn the hard way what those warning colours mean and stop attacking them.

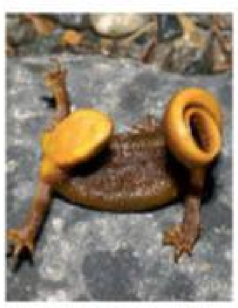
But because evolution occurs when a mutation spreads throughout a population, it is hard to see why mutations making animals brightly coloured would be beneficial and spread, as the first few animals with that trait would be much more likely to be caught by predators.

"You have this paradoxical catch-22 where, in order for predators to know that the bright colouration is associated with a chemical defence, they have to sample an individual, but sampling that individual kills that individual, so it prevents the spread of that adaptation," says Karl Loeffler-Henry at Carleton University in Ottawa, Canada.

Some amphibians, such as rough-skinned newts, have vivid colours only on body parts that are normally hidden. Such animals remain camouflaged at most times, but they may display their bright colours when they are threatened or when fleeing a predator.

Loeffler-Henry and his colleagues wondered if this could explain the paradox. Animals with usually hidden colours could spread in a population because they wouldn't be so vulnerable to predators. As the trait becomes more widespread, predators would learn its meaning, paving the way for the evolution of animals with brilliant colours on conspicuous body parts.

To test this idea, the researchers analysed the family trees of 1100 species of frog, newt and salamander. By comparing living animals, they worked out whether their immediate ancestors had conspicuous colours, usually hidden colours or no obvious colours at all. They discovered that amphibians with conspicuous colours almost always evolve from ones whose bright colours are usually hidden (*Science*, doi.org/j276).



GARY NAFIS

A rough-skinned newt reveals its conspicuous underside when threatened

"For amphibians, this seems to be the primary route," says Loeffler-Henry. "It does resolve the paradox for amphibians, I would say."

"This study presents strong evidence," says David Kikuchi at Oregon State University. "It will really change the range of processes we think about when we consider warning signal evolution." ■

Michael Le Page

Health

Signs of cellular ageing start earlier in women than men

David Cox

CELLULAR ageing occurs at different times and rates in men and women, with female cells showing the hallmark signs in early adulthood, while in men these occur from age 40.

Michael Ben Ezra at the University of Copenhagen's Center for Healthy Aging in Denmark and his colleagues used machine learning to analyse 33 million biopsy reports taken from more than 4.9 million individuals, ranging from newborn babies to people over 100 years old, between 1970 and 2018. Transgender people weren't included.

After identifying markers of ageing, such as inflammation or the formation of giant cells, the researchers attempted to uncover whether the onset of these differs between the sexes.

They found that cellular ageing didn't appear to start in the men until age 40, but then happened very rapidly. In contrast, signs of ageing in the women seemed to begin at age 19, before progressing gradually (bioRxiv, doi.org/j3hx).

This may explain why women are more at risk of certain health complications, says Ben Ezra. "Women have higher levels of frailty throughout life, so that would fit with ageing beginning earlier in females."

However, the biopsies were taken when the participants sought medical attention. Male ageing may therefore appear to begin later, as men tend to seek medical help when their symptoms are more advanced than their female counterparts, says study co-author Morten Scheibye-Knudsen.

The researchers didn't account for how advanced the participants' health issues were when they sought medical attention, but Scheibye-Knudsen says that signs of cellular ageing could have been picked up in biopsies when the male participants were younger if they had seen a doctor earlier.



NIALL MCDIARMID/MILLENNIUM IMAGES, UK

Cellular ageing may differ substantially between the sexes

Charalampos Rallis at the University of Essex, UK, says that previous research suggests that a man's risk of immune dysfunction becomes more pronounced with age, and the effects of age-related inflammation on tissues are more substantial in older men than in women of the same age.

> "It could help us learn the age at which a person is most at risk of conditions affecting certain organs"

Rallis also notes, however, that the samples in the latest study were taken from people in some state of ill health, with certain medical conditions potentially having a greater impact on ageing than others.

"They are looking at [different] disease pathologies and the timing of them becoming apparent in men and women, so it is quite tricky to directly relate [the results] to the ageing process itself," he says.

Ideally, this study would have been carried out using biopsies from a range of participants of different ages with no known health issues, says Rallis.

The biopsies were also only from white people, so the results may not apply to people of other ethnicities, says Ben Ezra.

Nevertheless, the results suggest that tissues in the liver age in a slow and predictable way, whereas tissues in the heart age more erratically, regardless of whether the biopsy was taken from a man or woman.

This could help us learn the age at which a person is most at risk of conditions that affect specific organs, says Scheibye-Knudsen.

With more research, the database of biopsy reports could be combined with an artificial intelligence that receives such reports and then predicts a person's risk of medical conditions according to their age, says Ben Ezra. ■

Marine biology

Algae-farming fish help coral bounce back from bleaching

Carolyn Wilke

FISH that tend patches of stringy algae seem to shield branching corals from the worst effects of marine heat waves and even help them recover after bleaching.

In 2019, the reefs near the island of Moorea in the South Pacific Ocean endured their worst heat stress event in 14 years. The unusually warm waters made branching corals there bleach en masse, losing the symbiotic algae living in them that supply most of their food.

In some areas, "all of the colonies that used to be alive and had colour to them were now completely bleached white and on their way to dying", says Randi Honeycutt, who studied the coral while at the University of California, Santa Barbara.

Some of Moorea's coral colonies were in the "gardens" defended by territorial farmerfish (*Stegastes nigricans*), which cultivate their own algae for food and chase off other fish. So, Honeycutt and her colleagues decided to see whether the presence of these fish affected coral bleaching and recovery.

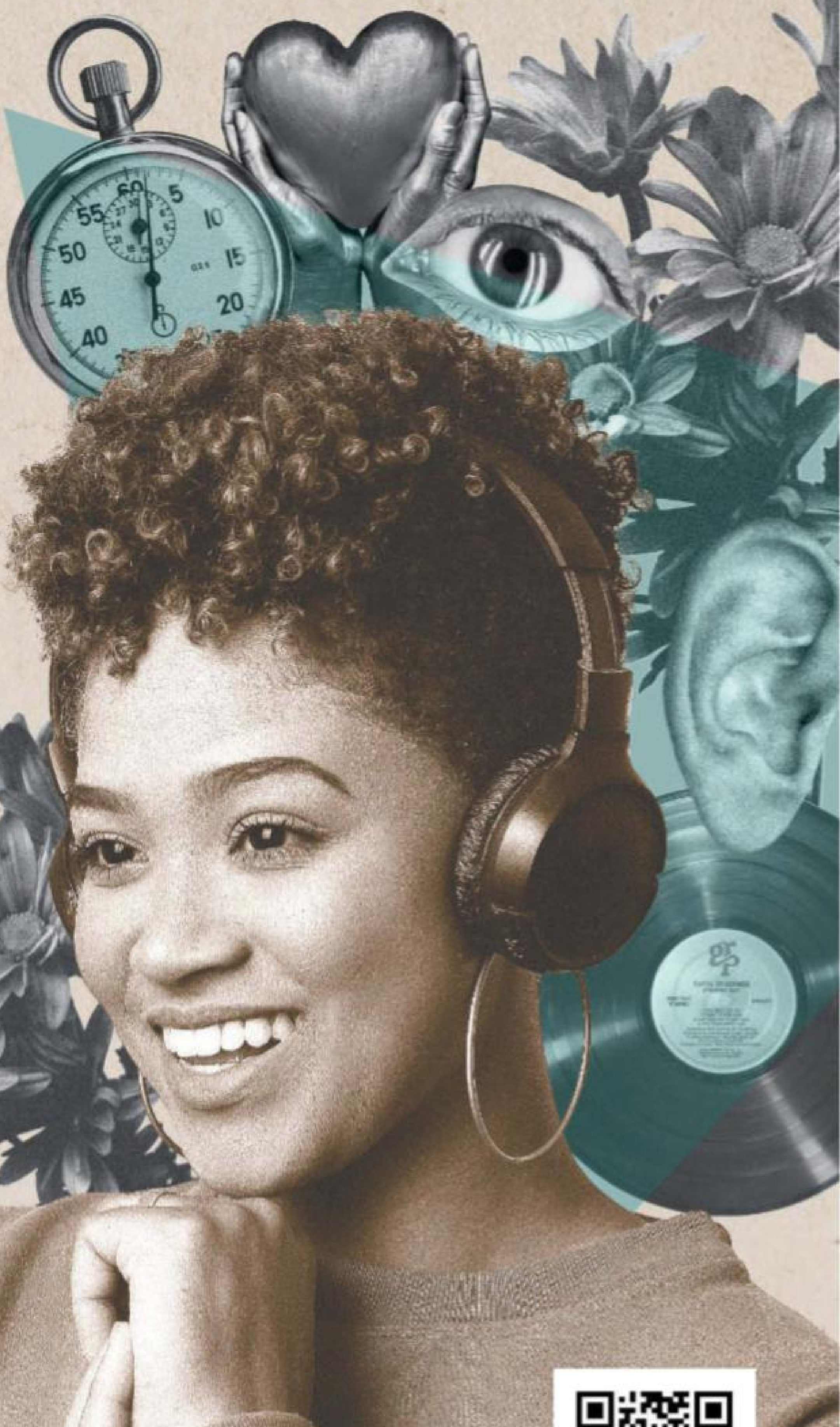
By visiting more than 1100 coral colonies, the researchers found that the presence of farmerfish gardens didn't influence how much a colony bleached. But continuing to watch nearly 400 colonies revealed that, after one year, 44 per cent of colonies inside gardens died compared with 67 per cent outside gardens. What's more, colonies on the turf of the territorial fish were twice as likely to see their living tissue recover to pre-bleaching levels (*PLoS One*, doi.org/j286).

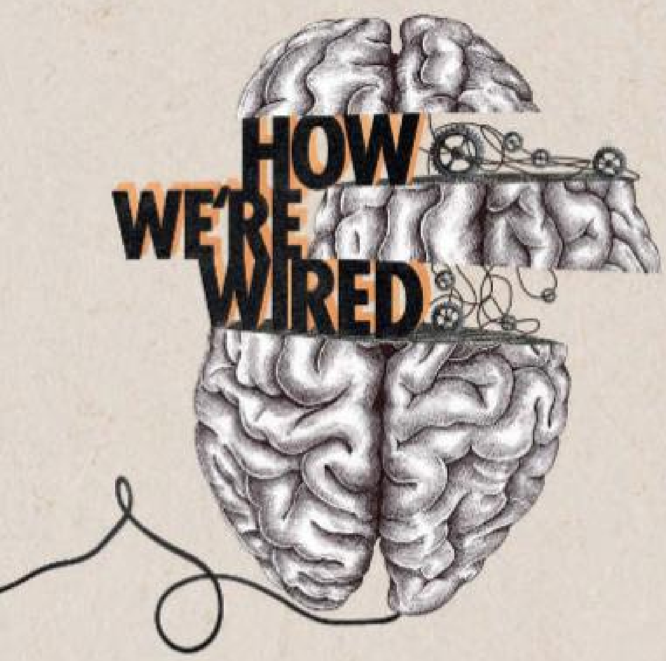
Nitrogen in fish urine could be boosting the growth of the corals' algal partners, suggest the researchers, or the fish may chase off coral-nibblers, enabling the corals to use an alternative feeding method: extending tentacles to grab zooplankton. ■

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Health

Umbilical blood stem cell transplant puts woman in HIV remission

Jacklin Kwan

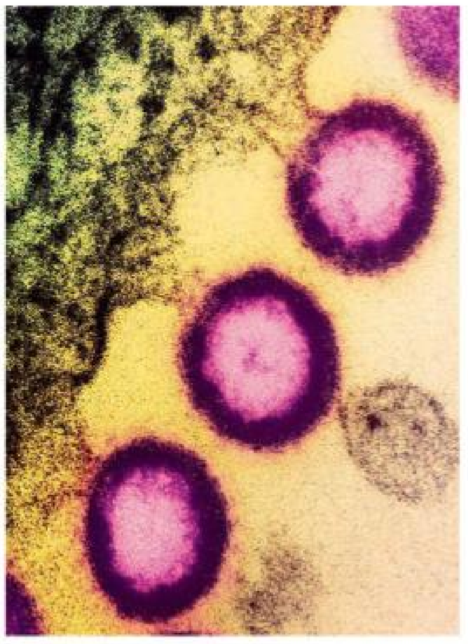
RECEIVING a transplant of stem cells from umbilical cord blood has caused a mixed-race woman to go into remission for HIV for the first time.

The woman, known as the New York patient, has been clear of detectable HIV since 2017, after she received HIV-resistant stem cells – which can turn into different types of blood cell – that had been harvested from umbilical cord blood to treat her leukaemia.

Several people have gone into remission from HIV after receiving stem cells from adult donors who carry two copies of a mutation of the *CCR5* gene. This mutation prevents the virus from infecting healthy cells.

With any stem cell transplant, recipients can only receive donations from people with matching tissue types to reduce the risk that their immune system will attack the transplanted tissue.

Since tissue types are inherited, a person's ethnicity influences the chance of finding a match. Having two copies of the *CCR5* mutation is rare, existing in only around 1 per cent of people of northern European ancestry and being even less common in other populations.



NIAID

HIV viruses (pink) replicating from a cell's membrane

To overcome the lack of suitable donors, doctors infused umbilical cord blood into the New York patient, who identifies as mixed race (*Cell*, doi.org/grxpmw).

She also received stem cells from a relative. Umbilical cord blood can contain few stem cells, so mixing it with stem cells from a relative gives it a "kick start", Yvonne Bryson at the University of California, Los Angeles, who was involved in the patient's treatment, said in a statement.

Using umbilical cord blood makes it easier to find transplant matches, as large repositories of frozen samples have been donated by people who gave birth in hospitals, says Jingmei Hsu at the New York Presbyterian Hospital.

Most people with HIV can lower the virus in their blood to undetectable levels by taking antiretroviral drugs, which stop the virus from replicating.

Stem cell transplants are therefore only considered for people with HIV who also have advanced blood cancer, which can be treated with the procedure. The New York patient no longer requires antiretroviral drugs and is in remission for her leukaemia.

Such transplants involve using chemotherapy to kill a person's red blood cells, before infusing them with donated stem cells. They receive immunosuppressant drugs – typically for life – to reduce the risk of their immune system rejecting the transplant, but this raises their risk of infections.

> "With more success, like this story, we can open doors for people with HIV in very, very high-risk situations"

The recipient's body can also reject the transplant via graft versus host disease (GvHD), when immune cells among the donated stem cells attack the recipient's own cells.

The New York patient experienced mild GvHD, such as gastrointestinal discomfort. According to Hsu, umbilical cord blood hasn't been exposed to many toxins or infections. Its T-cells, a type of immune cell involved in GvHD, are therefore less reactive to cells that may not be a perfect match, she says.

"With more success, like this story, we can open doors for all patients in these very, very high-risk situations," says Hsu. ■

Plants

Gene-edited rice may be able to grow in Martian soil

A GENE has been found in rice plants that, when modified, seems to give them a better chance of surviving in the harsh soil on Mars, known as regolith.

Martian soil has fewer nutrients than Earth soil and has compounds that can be toxic to some plants. To see how rice handles such conditions, Abhilash Ramachandran at the University of Arkansas and his colleagues grew rice seeds in a series of mixtures of regular potting soil and an artificial Mars regolith called MMS-1, ranging from all potting soil to all MMS-1. The researchers found that rice could grow in mixtures with as little as 25 per cent potting soil almost as well as rice grown in 100 per cent potting soil.

However, the rice grown in all artificial regolith had much shorter shoots and longer roots than the rice grown with any potting soil. The longer the root, the fewer nutrients the soil has, said Ramachandran in a presentation at the Lunar and Planetary Science Conference in Houston, Texas, on 13 March.



SHUTTERSTOCK/SU PRASERT

Modified rice plants may be able to grow even in low-nutrient conditions

When the researchers analysed the genetics of the rice plants, they found that a gene called *OsSnRK1* had an outsized effect on the plants' reaction to bad soil. They used the gene-editing technique CRISPR to create rice seeds with mutated *OsSnRK1* genes that fared better in poor-quality soil mixtures than the rice plants that hadn't been modified.

These were only preliminary tests, and the researchers plan to test seeds with further mutations to adapt to Martian soil, as well as additional changes to adjust to the tenuous carbon dioxide atmosphere of Mars, which is so thin it will probably pose more problems for the plants.

"It is very challenging to grow plants on Mars, but it is not impossible," said Ramachandran. ■

Leah Crane

Space

Expanding vent is a sign that Venus is volcanically active

Alex Wilkins

A VOLCANIC vent on Venus that changed shape over a period of eight months is the first direct evidence that our neighbouring planet is volcanically active.

Venus has many prominent volcanic features, such as vents and the dry beds of lava lakes, but it was unclear whether these were remnants of a distant volcanic past or signs of current activity.

Between 1990 and 1994, NASA's Magellan satellite used radar to map Venus's surface in detail, including its volcanic features. But researchers have only recently had computers powerful enough to properly analyse the vast amount of data this work generated.

Even then, they had to look through the images by eye, because the way in which Magellan mapped Venus – by taking photos every eight months at different viewing angles – made it impossible to automatically search for changes in surface features.

"The daunting aspect of this is it's a needle-in-a-haystack search, where there's no guarantee that the needle exists," says Robert Herrick at the University of Alaska Fairbanks, who, along with Scott Hensley at NASA's Jet Propulsion Laboratory in California, presented the findings at the Lunar and Planetary Science Conference in Houston, Texas, on 15 March.

By combing through areas of Venus's surface in which they thought volcanic activity was more likely, the pair found the vent, which is in the Maat Mons volcano system, home to the planet's highest volcano.

Between February and October 1991, the vent changed from being a circular, 2-square-kilometre hole to a more shallow, irregular hole with an area almost twice as big. In the later images, there were also features downhill from the vent that looked like active lava flows, but the images weren't clear enough to fully make them out (*Science*, doi.org/j26d).

8km

Height of the Maat Mons volcano peak on Venus

"A reasonable interpretation is that a lava lake formed over those eight months, and that volcanism occurred downhill," says Herrick.

While the finding validates many predictions and hypotheses about active volcanism on Venus, it tells us little about the frequency of volcanic eruptions on the planet because it is the only sample we have. But the fact that we saw it at all could tell us something.

"There's the possibility that we observed the only thing that's happened on Venus in the last 1000 years and got incredibly lucky, but the odds are that if we saw something change over a short, eight-month period, then at least volcanic eruptions occur on Venus at a similar sort of level to the intraplate volcanism on Earth, in the every-few-months time frame," says Herrick.

"We know Venus must be active, but demonstrating it from Magellan data has, until now, proven elusive," says Philippa Mason at Imperial College London.

Confirming that Venus is volcanically active is especially useful given upcoming missions to Venus, says Mason, such as the European Space Agency's EnVision and NASA's VERITAS satellites. These missions will use radar – like Magellan did, but in a more advanced form – to map the planet's surface and interior, as well as spectroscopy to analyse gases in its atmosphere.



DAVID P. ANDERSON, SMU/NASA SCIENCE PHOTO LIBRARY

A 3D view of the Maat Mons volcano system on Venus

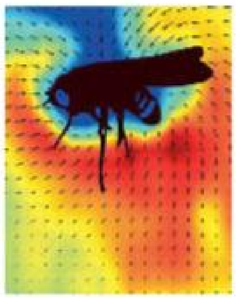
Life

Jumping parasitic worms use static to hit their targets

Karmela Padavic-Callaghan

TINY parasitic worms may be exceptionally good at jumping onto their prey because they are electrically attracted to them.

Roundworms (*Steinernema carpocapsae*) attach to insects like bees or fruit flies to feed on them, and are among nature's most powerful jumpers despite being only a millimetre long. They launch into the air, then spin in a series of flips until they land headfirst.



VICTOR M. ORTEGA-JIMENEZ

A map of the electric field around a charged fruit fly

Researchers have previously studied how the structure of the worms' muscles helps them jump so well, but Víctor Ortega Jiménez at the University of Maine and his team now think that electric attraction between the worms and their prey might play a role as well.

The researchers used a high-speed camera to record worms jumping onto a fruit fly that was held in place a few millimetres above them. When the team applied a small electric voltage to the insect, the worm's trajectory would take a sharp, mid-air turn towards the fly, no matter where it started its jump. In experiments where the researchers made the fly electrically neutral, worms that didn't start their jump close to the fly never successfully hit their target.

In nature, flying insects build a static electric charge as they flap their wings against particles of air, so the experiment imitated natural conditions by charging the fly, says Jiménez, who presented the work at a meeting of the American Physical Society in Las Vegas, Nevada, on 6 March.

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Wildlife

Killer infection on the rise in Africa

A FUNGUS deadly to frogs and other amphibians has been rapidly spreading under the radar in Africa in recent decades.

Infection by *Batrachochytrium dendrobatidis* (also known as Bd), is linked to population collapses in the Americas and Australia.

Vance Vredenburg at San Francisco State University and his team used museum collections of amphibians to gauge the impact in Africa, as fungi and other parasites often get preserved with animals.

They found that Bd kept a low profile there during the 1900s, consistently appearing in less than 5 per cent of animals tested. But that changed at the turn of the century, with prevalence soaring to around 20 per cent across the continent (*Frontiers in Conservation Science*, doi.org/grxd3d). **Catherine Offord**



GUIDO MIETH/GETTY IMAGES

Zoology

How shiny ghost fish gets its many colours

WE NOW know how ghost catfish get their rainbow shine: from fibres in their muscles, unlike many other species that shimmer.

Ghost catfish (*Kryptopterus vitreolus*) are almost completely transparent. When light shines through their bodies, they take on an iridescent shimmer despite lacking pigment in the transparent parts of their bodies. Qibin Zhao at Shanghai Jiao Tong University in China and his team examined the fish and tissue samples to figure out how that iridescence arises.

They found it comes from fibres called sarcomeres, which mediate the contraction and relaxation of muscles. When light shines through the fish, these sarcomeres act a bit like prisms, breaking the light into its constituent colours (*Proceedings of the National Academy of Sciences*, doi.org/grw8cf). **Leah Crane**

Health

Coffee habit link to smaller diabetes risk and lower BMI

GENETIC evidence indicates that higher levels of caffeine in a person's blood may be linked with lower weight and reduced diabetes risk.

But people shouldn't assume that drinking more coffee will be a route to weight loss, says Dipender Gill at Imperial College London, who helped carry out the study.

Many people have several coffees or caffeinated soft drinks a day and numerous studies have previously suggested that caffeine consumption is linked with lower weight. But these were mainly observational studies that recorded people's health and their caffeine consumption, making it hard to know if caffeine caused the effects or just correlated with them.

Gill's team used an alternative approach, looking at genetic differences in how quickly people break down caffeine to mimic the effects of giving different doses in a randomised trial.

There are two genes that affect our ability to break down caffeine, meaning that after consuming the same amount of it, people with different variants would have different levels of it in their blood.

Gill and his colleagues analysed data from several previous studies that sequenced people's DNA and tracked their health. They included nearly 10,000 people in total, mostly of European ancestry.

The team found that people genetically predisposed to have higher caffeine levels had a lower body mass index (BMI), lower fat mass and a lower likelihood of having type 2 diabetes (*BMJ Medicine*, doi.org/j27z).

Despite this, Gill says people seeking to lose weight should be wary, as caffeine can affect sleep and heart function. Clare Wilson

Really brief



PATRICK WEBSTER

Australian goshawk is rapidly dying out

Red goshawks – colourful birds of prey that are endemic to Australia – have been rapidly vanishing from the continent for decades. This striking species has gone extinct in more than a third of its historical range over the past four decades (*Emu – Austral Ornithology*, doi.org/grt8d9).

Windows filled with wood are warmer

A transparent aerogel made from wood could replace air in double-glazed windows. The material could be retrofitted to existing windows, increasing their insulating ability. A filling about 2.5 centimetres thick could make a window as insulating as a wall (*Nature Energy*, doi.org/j273).

The dinosaur with the longest neck

A sauropod from the Late Jurassic epoch, *Mamenchisaurus sinocanadorum*, had the longest neck of any dinosaur on record, stretching 15.1 metres. That is six times longer than the neck of a giraffe (*Journal of Systematic Palaeontology*, doi.org/grxhxv).

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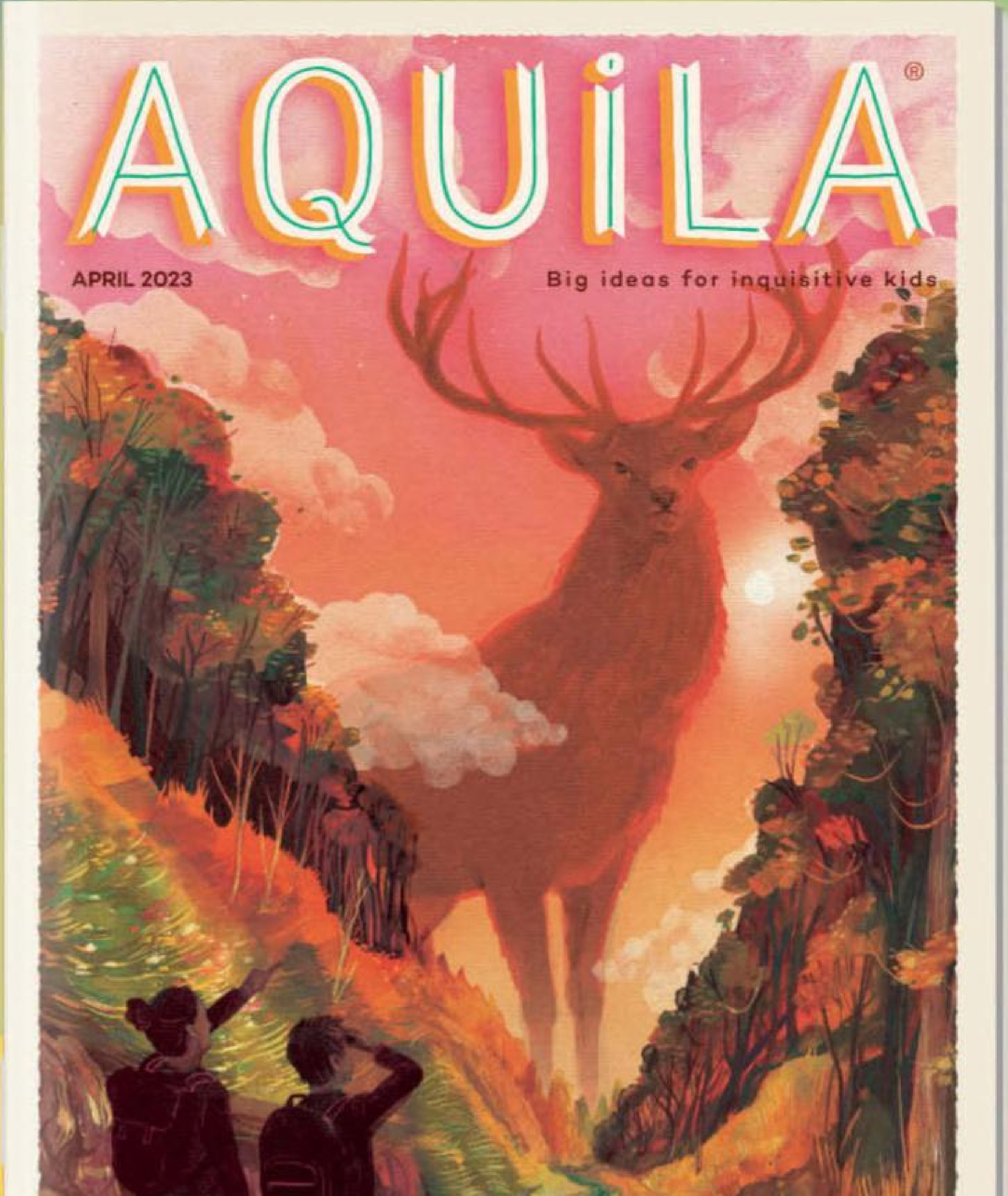
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Avoid seeing human traits in chatbots, says **Alex Wilkins** p28

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Imagining the future of our warming world in *Extrapolations* p34

Culture columnist
Simon Ings on four films about fire and the environment p36

Comment

It's now or never

Achieving a sustainable human population is critical if we are to address our overconsumption of resources, argues **Chris Packham**

TODAY, there are more humans on Earth than ever and nature is in freefall. In just 50 years, wildlife populations have dropped on average by 69 per cent. In the same period, our population has doubled, and demand for non-living and living material from Earth has grown six times. The biggest culprits of biodiversity loss are habitat destruction and overexploitation of species, both driven by wholly unsustainable consumption and exacerbated by increasing human numbers. It is critical we address this overconsumption, and that means evaluating the impact our species' population growth is having on the collapse of the natural world.



SIMONE ROTELLA

December's biodiversity summit in Montreal, Canada, didn't meet the challenges we face. Two of the 23 targets are intended to address consumption and speak of "significantly reducing overconsumption". But the concept is vaguely defined and unquantified, lacking mechanisms for any real delivery. Given all the goals of the previous biodiversity protection plan were missed, it is frankly impossible to imagine that governments will summon the bravery to grasp this nettle. We are thus precipitating the sixth mass extermination event of the world's wildlife, and staring down the barrel of our own extinction too.

The global north, which has benefited most from industrialisation, is driving that unsustainable consumption and is the most responsible for global warming, deforestation and the destruction of species. So it is essential that those of us in the global north fundamentally change our lifestyles and challenge the economic principles that drive us to consume ever more. But can I? Will you? What if we fail? And is it ethically tolerable that we super-consumers survive on the resource poverty of the rest of the world?

No, it isn't. Globally, equity must lie at the very core of our species' future. We must urgently address gender inequality, improve education and tackle poverty. We are one species, with one big problem and one last chance to sort it out. And we can only do that together.

In May 2019, the global assessment by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) identified human population growth and dynamics, alongside excess consumption and other factors, to be critical indirect drivers of biodiversity loss. In its blunt words, "our increasing numbers drive degradation". So surely we must consider that achieving a sustainable human population is essential for our survival.

In November last year, our population reached 8 billion and current United Nations projections are that it will peak at 10.4 billion in the 2080s. The goal of the UN Convention on Biological Diversity is for us to live "in harmony with nature" by 2050. Let me be emphatically clear: there is no doubt that the 1.7 billion more of us who are predicted by that date will make this significantly harder to achieve. However much we try to reduce our consumption and our impact, every innovation, initiative and regulation that moves us forward will have an incrementally lower impact due to the pressure to meet the needs of each of those extra 1.7 billion people.

And let me again be emphatically clear: it isn't about any particular humans among those billions, this is about us as a species of resource-consuming organisms.

We must now urgently ensure governments approach their tasks with the commitment and intelligence to go beyond any short-sighted, short-term fixes. Tolerating the genocidal notion that "economic growth" – for which read "growth in consumption" – is the answer to our problems, and totally ignoring unsustainable population growth, must end. Or we all die. ▮



Chris Packham is an author, television presenter and patron of Population Matters

Artificially intelligent

A robotic personality

For all their unsettling emergent abilities, chatbots are still just next-word predictors and we need to be wary of anthropomorphising them, warns **Alex Wilkins**



Alex Wilkins is a *New Scientist* reporter covering artificial intelligence, physics and space. Artificially intelligent is a column that cuts through the hype and looks at what AI is really capable of and what it means for us. You can follow him @AlexWilkins22

Alex's week

What I'm reading

The Earthsea Quartet *by Ursula K. Le Guin – it is nice to live in another world for a little while where there are no chatbots to be seen.*

What I'm watching

Welcome to Wrexham, *a traipse through Welsh history and UK football culture with a sprinkling of Hollywood magic.*

What I'm working on

After being struck down with a winter lurgy, I have been trying to get back on the bicycle in preparation for an upcoming off-road trip.

Up next week: Chanda Prescod-Weinstein

UNTIL Microsoft curtailed the capabilities of its Bing chatbot – codenamed Sydney and powered by an advanced version of OpenAI's ChatGPT model – there were a chaotic few days last month when it was threatening, cajoling, falling in love with and terrifying its beta testers.

Even journalists who regularly write about artificial intelligence expressed surprise: they know these programs are just statistical models of the language on the internet, but they still found Sydney's "personality" unsettling and eerily human.

Bing's chatbot has yet to be rolled out to the world at large and its curtailment has prevented it from going off the rails again, but it remains unnerving. If the original Sydney were introduced to a more unfamiliar audience, what actions might it convince people to take, and might they believe it is something more than a statistical language model – a mistake even experienced professionals sometimes make?

It has long been standard practice to imbue chatbots with a human-like personality, from ELIZA, a simple chatbot designed to emulate the questioning style of a Rogerian psychotherapist that was created by computer scientist Joseph Weizenbaum at MIT in 1964, to Microsoft's more recent Tay chatbot in 2016, which was quickly taken offline after being tricked into racist rants.

It now seems a given for chatbots' responses to resemble those of humans, from which problems constantly seem to spew: a Google engineer thought the firm's LaMDA AI was sentient, for example, and ChatGPT has had its fair share of difficulties.

These human imitators can also disguise what is really happening under the hood. Murray Shanahan, a researcher at DeepMind in London, recently spelled out exactly how these AIs work in a preprint titled "Talking about large language models". He reiterates that, despite how advanced their plumbing has become and the emergent abilities they display, all they are doing is predicting the most likely subsequent word in a sequence based on all the relationships of words they have seen.

When such a chatbot leads people to believe it is something more than that, according to Shanahan, it is a form of deception on the part of the chatbot. Not only could this fool people into trusting its capabilities more than they should, but it might also play on people's sympathies for what they feel to be their fellow human, coercing them into acts they might not otherwise do.

> **"We can convince ourselves that these AI models are something more, even when we know that isn't the case"**

AI researchers have suggested explicitly disclosing that a chatbot is non-human to improve trust between human and AI, but a study in 2020 by Nika Meyer at the University of Göttingen in Germany and her colleagues revealed a problem with this approach. If a chatbot succeeds in its goals, people are less likely to trust the outcome if they know it is an AI model. If it fails to help, on the other hand, then people tend to be more sympathetic, knowing it is "just" an AI.

So it appears that, in some cases, we might have to make a trade-off between the psychological discomfort we feel from taking advice from an AI and the risks we take on by regarding a chatbot as being like a human and deceiving ourselves. We can try to protect ourselves by remembering that it is a deception, but, as experiences with Bing's Sydney have shown, we can still end up convincing ourselves that these AI models are something more, even when we know that isn't the case.

While the convention is still to make chatbots converse like humans, there is a growing movement to reconsider this. Linguist Emily Bender at the University of Washington in Seattle and her colleagues wrote a paper in 2021, "On the dangers of stochastic parrots", in which they argue that the mimicking ability of large language models is one of the key factors in their potentially harmful downstream effects. "We call on the field to recognise that applications that aim to believably mimic humans bring risk of extreme harms," they wrote.

For those who talk about a rapidly approaching doomsday AI future, humans being duped by convincing AI chatbots may feel like an inevitability. But there are many intentional choices when designing a large language model, like the personality with which it speaks, or whether it has one in the first place.

These choices should be made at a societal level, not in the backrooms of a handful of rich tech companies, such as OpenAI and Google. While companies like Stability AI have made open-source alternatives to text-to-image AIs, there is still no open-source version of something like ChatGPT. Until there is, our tendency to see human attributes where they don't exist may lead us into murky waters. ▮





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It’s snowtime!

Photographer Jack Dykinga
Agency NaturePL

SNOW in hot deserts tends to be an unusual sight, but this recent snap of the white-capped expanse of the Sonoran desert, which covers more than 250,000 square kilometres in the US and Mexico, is even rarer than most.

What makes the scene so special is the fact that this area is known for having a subtropical climate that can often see temperatures reach 48°C (118°F) in the summer, while remaining mild during the winter months. But photographer Jack Dykinga managed to capture images of the ground earlier this month when it was blanketed in 10 centimetres (4 inches) of snow, albeit just for a fleeting 4 hours – something that, according to him, hasn’t occurred in a decade.

Dykinga, who has been photographing this desert for more than 40 years, says he felt “pure joy and wonder, along with anxiety” as he hurried to reach the optimum locations to document the snow before it all melted.

“It’s very rare to see this amount,” he says. “In the south-west desert in a long drought period, it’s a time to celebrate!”

It isn’t totally clear why the snowfall happened, but it was in part due to the La Niña weather event, which is the result of the sea surface temperature in parts of the Pacific Ocean periodically dropping below average. Another factor was cold air blowing over from the Arctic.

Gege Li

Editor's pick

Is space telescope seeing evidence for exotic theory?

4 March, p 19

From Matthew Tucker, Sydney, Australia

You report that the James Webb Space Telescope has detected very distant galaxies that seem far too massive to have formed so early in the universe, potentially upending our current theories for such objects.

Could they be evidence in support of the idea that our observable universe is actually the inside of a black hole? What the JWST may have been seeing wasn't galaxies formed in an inexplicable way, but those that had formed outside the observable universe and that had fallen across the event horizon of this cosmic black hole.

The electrome may have me reaching for a foil hat

25 February, p 38

From Peter Holness, Hertford, UK

Sally Adee's look at the human "electrome" is the most important biological article your magazine has published because it seems to bust a myth. I never bought into the prevailing orthodoxy that says proliferating, low-power, athermal radio and microwave signals can't affect us biologically.

Shifting electromagnetic fields can jiggle ion channels and alter gene expression. Haemoglobin can have a magnetic moment. Perhaps that jiggles too. Should I join the tinfoil hat brigade?

Don't forget embodied energy toll of new homes

25 February, p 11

From Simon Conolly, Cork, Ireland

You reported on future houses that claim an impressively low day-to-day energy use. However, it is important to remember that, as we progressively reduce this form of energy use, we ignore embodied energy – that required to create the building – at our peril.

In homes of the sort described, this is liable to exceed several decades of carbon emissions in operational energy thanks to use of brick, concrete floors and concrete roof tiles, materials that all have high-carbon footprints and high embodied energy. It is about time materials and buildings were required to have embodied energy ratings as well.

On the delights of observing the moon

4 February, p 51

From Roderick Sykes, Boudrac, France

Thanks to Abigail Beall for another great astronomical piece with her look at the delights of the full moon. I have been moonstruck for most of my life, but for me, the magic lies more at the new moon.

I was recently amazed to see, through binoculars, a very clear new moon crescent soon after sunset. I was particularly looking for "Earthshine" – when the dark part of the moon is illuminated by light reflected from Earth – when I saw, right on the line dividing the sunlit lunar surface from the dark part, a row of what looked like pimples. I assume they were mountains illuminated from the side, and they reminded me of Pyrenean peaks. In 78 years of looking at the moon, this was the first time I had seen this spectacle.

It's a no from me for this grand geoengineering idea

4 February, p 16

From Chas Bazeley, Colchester, Essex, UK

Grandiose schemes to "save the planet", such as mining and spreading large amounts of rock to accelerate carbon dioxide absorption by chemical weathering, might be a good idea were it not for the amount of CO_2 and pollution generated to achieve this. Our best hope of prolonging our stay on Earth is to reduce industrial activity, not increase it.

Even with theory of mind, AIs will still seem odd

18 February, p 46

From Steve Dalton, Chipstead, Kent, UK

I enjoyed your look at AI theory of mind (ToM), related research and the promise of smarter AI assistants as a result of this work.

However, I can't help feeling that something isn't quite right about where this is heading. As one of the researchers says, an AI ToM won't be like our ToM, so the actions and judgements resulting from that won't be the same either. Even if the imitation becomes very human-like, it seems likely that there will be an "uncanny valley" effect, or worse.

Whether we are on a path to sentient machines we are – and I am not convinced of that – will these AI "assistants" be at all likeable or well-intentioned? As we know, possession of human ToM and sentience is no guarantee of likeability or trustworthiness.

Fed up with the desire to spin our lives in this way

7 January, p 33

From Caroline Deforche, Lichtervelde, Belgium

According to your guide to being your own hero, psychologists say we should spin our memories "into a well-told life narrative" to "help us achieve our aspirations for self-improvement". Why always this pressure to perform better, because that is what it comes down to (which isn't the same as saying that unhealthy behaviour shouldn't be changed)?

Why don't psychologists give a message about being content with who we are and accepting what we have done so far? Control over everything is an illusion.

What I found most insightful were psychologist Kate McLean's reflections. Indeed, we don't have to look for silver linings everywhere. Some events just suck and some choices we made were just stupid, or we simply had bad luck. Why not admit this and live with it? Why should we have to sugarcoat our story? No one is completely the author of their own destiny and no one can mould themselves into the perfect shape.

Water and waste don't just magically arrive and leave

11 February, p 36

From Guy Cox, Sydney, Australia

There seem to be two glaring omissions in the assessment of energy use for the 2000-watt challenge. I live off-grid and one of the greatest loads on our solar power system is the water pump that supplies the house with filtered water from our rainwater tank. A smaller, but not negligible, one is the power drawn by our simple sewage treatment system. It seems some people assume that water just comes and sewage just goes. Not so. Both require energy.

From Mirco Elena, Trento, Italy

James Dinneen regrets that he has to open his windows given the excessive heating in winter. He could avoid this practice by covering the radiators with insulating materials (a thick blanket, or enclosing them in a "box" made of polystyrene). In this way, he could get nearer to his 2000-watt target.

For the record

The Hoover dam had a maximum power output of 2080 megawatts before river flows declined (4 March, p 27).

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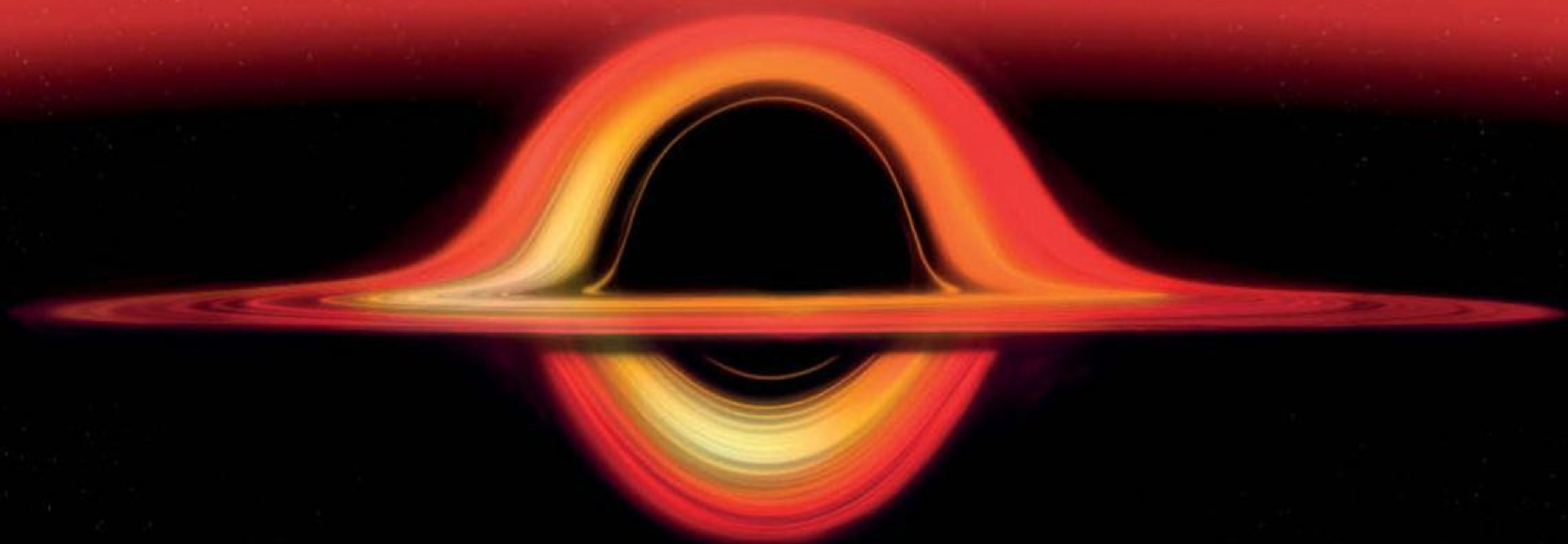
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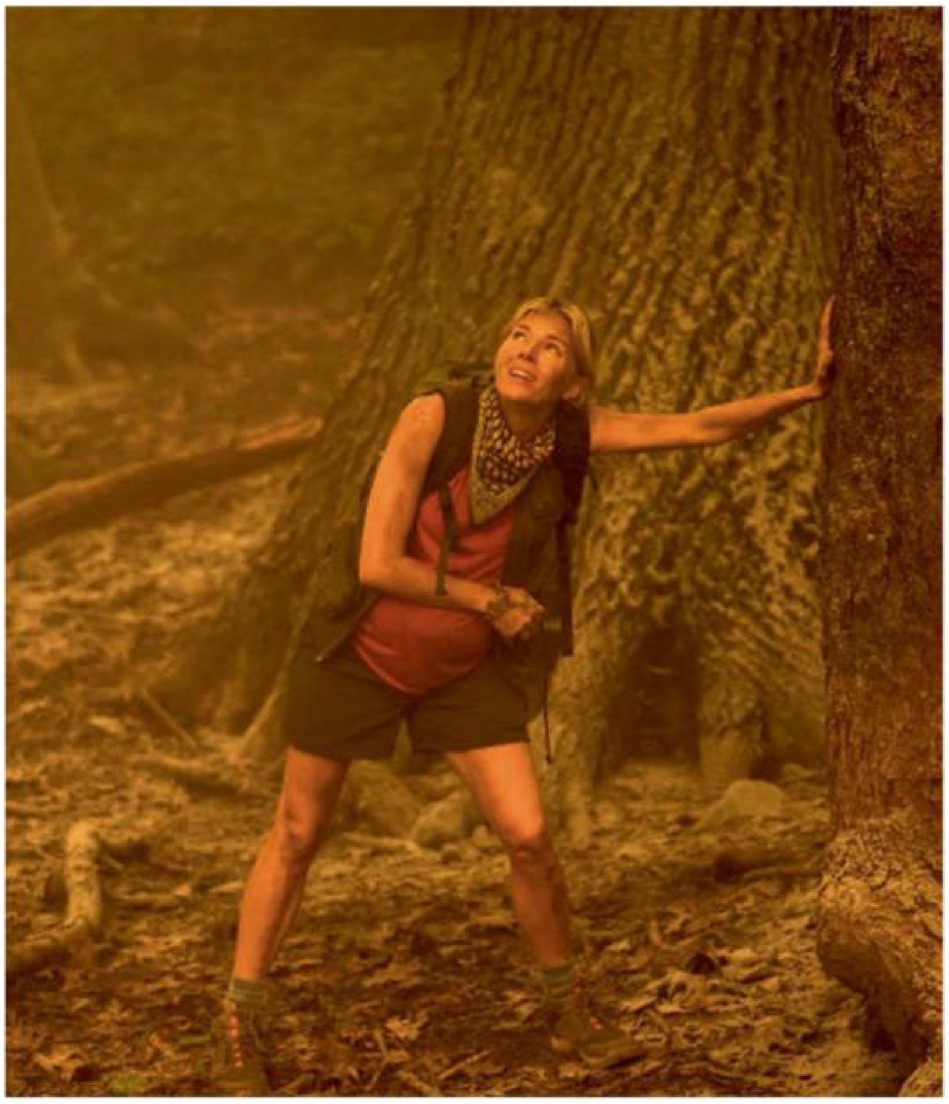
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Living in Earth's dark future

It is crunch time for the planet's climate in a sci-fi that takes the sledgehammer approach. But does it do enough to make us really care, asks **Jon O'Brien**

TV
Extrapolations
Scott Z. Burns
Apple TV+



ZACH DILGARD/APPLE TV+

Sienna Miller joins a star-studded cast as an animal conservationist

SIENNA MILLER as a conflicted animal conservationist. Kit Harington as a smarmy tech overlord. Meryl Streep as, erm, among other things, the voice of a humpback whale. If star power could be converted into energy, then *Extrapolations* from Apple TV+ would have enough to fuel the national grid.

The brainchild of Scott Z. Burns, producer of *An Inconvenient Truth*, the interweaving eight-part drama gives its ridiculously stacked cast (I haven't even mentioned Forest Whitaker, Diane Lane, Marion Cotillard, Edward Norton, Tobey Maguire or Eiza González) a rather weighty issue to tackle: the end of civilisation as we know it.

With its A-list talent and apocalyptic themes, comparisons will inevitably be made with *Don't Look Up*. But while the Netflix movie is more of an allegory for climate change, *Extrapolations* delivers an explicit warning. As news footage in the opening exposition dump reveals, a rise in the average global temperature of nearly 2°C from pre-industrial levels has caused mass forest fires, droughts, winds and floods. And things are about to get worse.

Set in 2037, the first of the three episodes available for review is something of a whirlwind itself, lurching from the Arctic circle to the Adirondack mountains in New York and from brash corporate satire to heartfelt family drama without much pause for breath. *Extrapolations* isn't exactly subtle in its messaging, either, with even fleeting characters, like Heather Graham's pop diva, prone to speechifying at the drop of a hat.

Of course, you could argue that such vital subject matter needs the sledgehammer approach, especially when a notable section of the political elite appears to echo Matthew Rhys's Junior, a pantomime-ish property magnate determined to build a super casino in Greenland. "It will all go to shit at the end of the century… But we'll be smiling in gold-plated coffins," he says. His comeuppance, by the way, is the show's first immensely satisfying moment. Still, there is a sense that Burns is preaching to the converted.

"AI technology is now so advanced it can even interpret a whale's musings on the music of Gustav Mahler"

Extrapolations finds more of a groove once it completes its world-building – or should that be world-ending? Fast-forwarding to 2046, episode two centres on Menagerie 21, a nature-interfering firm that revives extinct species using DNA from their last known survivor. Miller's Rebecca appears to be the company's only human conscience, striking up a touching relationship with the lone humpback whale, whose thoughts can be translated into human words (voiced by Streep, who is also briefly on screen as Rebecca's mother).

Sure, the whale seems to speak solely in grand poetic statements about humanity – artificial intelligence technology is now apparently so advanced it can even interpret sea mammals' musings on the music of Gustav Mahler – which requires a suspension of disbelief. But the bond between the pair gives *Extrapolations* a more hopeful and intimate side among the shots of doom and despair, no matter how *National Geographic*-esque those may be.

It is harder to get emotionally invested in the faith-based story set in 2047 that comprises the third episode, in which a rabbi (Daveed Diggs) battles to save his flooded Miami temple from ruin. The episode spends much of its lengthier running time posing a question it can't possibly answer: if there really is a God, why is there no divine intervention? Meanwhile, a jarring, on-the-nose homage to *Singin' in the Rain* feels designed purely to shoehorn in *Hamilton* star Diggs's musical talents, while a bribery subplot – which reaches the remarkable conclusion that power can corrupt – seems trite compared with the series' overarching theme.

Extrapolations is far more compelling when it delves deeper into the near-future setting, where every type of cancer has been eradicated, but so has a third of the animal kingdom. Only time will tell whether the planet of the show has a distant future: the finale propels the action to 2070, by which point we presume that Earth will be in recovery mode or facing total extinction. Should the show continue to lack focus, though, even climate activists may have stopped watching. ■

Jon O'Brien is a writer based in Preston, Lancashire, UK

The power of art

A fascinating update on how cultural pursuits help our brains narrowly misses out on being a great read, finds **Grace Wade**

Book

Your Brain on Art

Susan Magsamen and Ivy Ross

Canongate

THE first essay I wrote was about how much I hated my yellow bedroom. The walls were yellow. The blinds were yellow. Even the white furniture reflected the nauseating colour at me like a disco ball. My 11-year-old self described it as "a pee-coloured prison".

I bring this up because it exemplifies the big idea behind *Your Brain on Art: How the arts transform us* – that aesthetic experiences have a profound impact on our well-being. In the case of my bedroom, it was for the worse, but it can also be greatly to our advantage, argue Susan Magsamen, a researcher at Johns Hopkins University in Maryland, and Ivy Ross, Google's vice-president of hardware design. For them, leveraging this can boost not only mood, but also physical health.

***Your Brain on Art* is fascinating and frustrating. It is packed with interesting insights, but lacks the scientific rigour needed to elevate the book from good to great.**

The authors, who come from largely creative backgrounds, start out by laying a scientific foundation for discussing how the arts affect our bodies. They unpack key concepts such as neuroplasticity – the ability of our brains to change and rewire as they respond to learning and experience – and the default mode network, a system of interacting brain regions that kicks in when we aren't focused on the external world, such as when we daydream or our minds wander.

One particularly interesting idea they describe is the aesthetic triad, a model developed by Oshin Vartanian at the University of Toronto and Anjan Chatterjee at the University of Pennsylvania. This suggests that the brain's sensory, reward and meaning-making systems coordinate to perceive aesthetically pleasing experiences. Differences in the components may even explain liking or loathing yellow.

Unfortunately, this level of scientific analysis and detail falters further on, with some claims lacking concrete evidence. Magsamen and Ross suggest, for example, that people can access their unconscious by making circular, geometric shapes called mandalas, using unsubstantiated phrases such as "bringing buried emotions into meta-awareness".

Even when the authors do cite research, details are sometimes missing. At one point, they describe findings from a study at the Massachusetts Institute of Technology in which mice with an Alzheimer's-like disease were treated with sound therapy. After a week, the mice showed "vastly improved cognition", but we don't discover if "vastly" means an improvement of 5 or 50 per cent.

Magsamen and Ross needed to frame their evidence more carefully, especially by discussing limitations or introducing caveats. Despite this, there are plenty of interesting titbits highlighting the potential of the arts to heal bodies and minds. Take the virtual reality software, SnowWorld. Developed at the University of Washington, Seattle, it has been used for pain relief during the dressing of burns injuries, a process crucial to recovery. Patients reported feeling between 35 and 50 per cent less pain using the headset than with typical pain relief.

Other research by neurologists led by Janneke van Leeuwen at University College London shows that viewing art activates some brain regions involved in socialising. This may be because immersing ourselves in, say, a painting means engaging with the artist's thoughts, beliefs, emotions and ideas – and helps us connect with each other.

While *Your Brain on Art* needed to spend more time on the science, it does succeed handsomely at driving home the message that aesthetic engagement (no matter how small) can improve your life. This can be as simple as doodling away, or penning a manifesto to convince your parents to repaint your bedroom.



Immersive artworks like this one by teamLab activate some brain regions involved in socialising

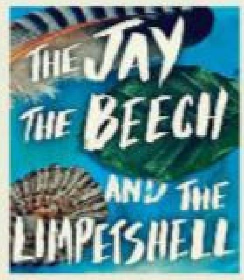
TEAMLAB

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Great Mysteries of Physics explores the multiverse, time and more in a six-part podcast. Miriam Frankel is joined by physicists such as Sean Carroll and *New Scientist* columnist Chanda Prescod-Weinstein (pictured).



Read

The Jay, the Beech and the Limpetshell is a natural history journey from Richard Smyth, as he hunts for wild things to share with his children in the rock pools, woods and moors of north-east England. On sale from 30 March in the UK and 12 September in the US.



Visit

Milk explores our relationship with the white stuff and the origins of its nutritious image. An 18th-century cream jug (pictured) is one item on show at the Wellcome Collection, London, from 30 March to 10 September.

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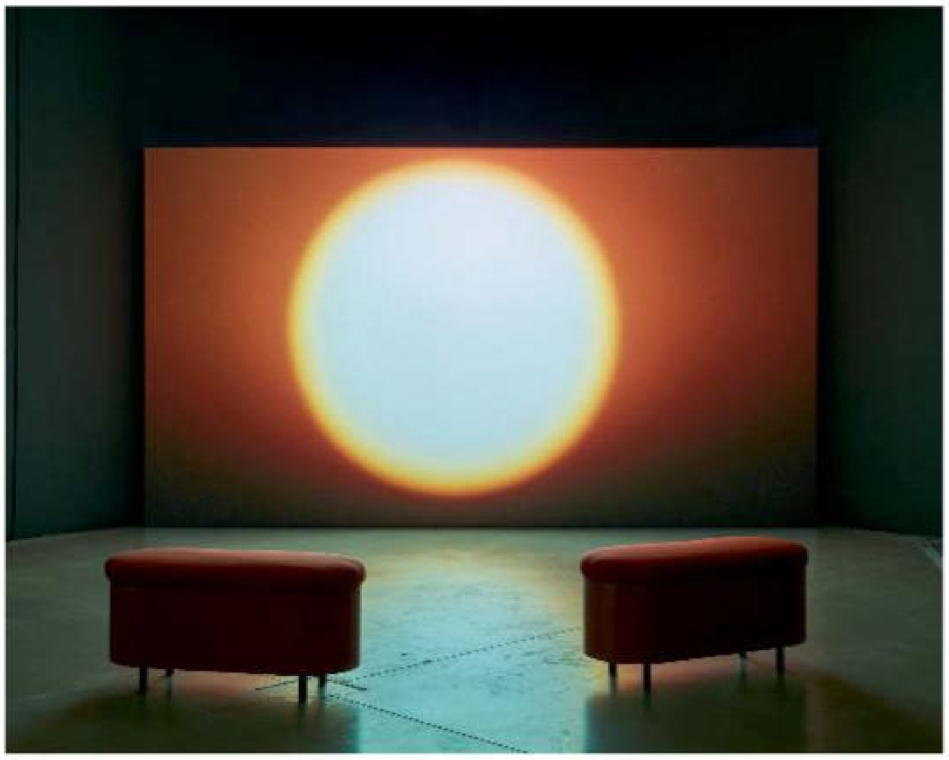
The film column

The coming fire

Atomic Light, an uneven collection of films by video and installation artist David Blandy, is rescued by the story of two solar astronomers who drew the sun on the day of the Hiroshima blast, says **Simon Ings**



Simon Ings is a novelist and science writer. Follow him on Instagram at @simon_ings



REECE STRAW/DAVID BLANDY

Atomic Light (installation view) by David Blandy at the John Hansard Gallery

Film
Atomic Light
David Blandy
John Hansard Gallery, University of Southampton, UK, until 6 May

ONE of four short films by video and installation artist David Blandy, called *The Edge of Forever*, opens with a mournful panning shot of Cuckmere Haven in East Sussex. A less apocalyptic place is hard to imagine: Cuckmere is one of the most ravishing spots in the south-east of England. Still, the voice-over insists we contemplate "a ravaged Earth" and "forgotten peoples" as we watch two children exploring a post-human future.

The only sign of former human habitation is an observatory (the now-deserted Royal Observatory at Herstmonceux Castle). The children enter and study the leavings of dead technologies and abandoned ambitions, steeped in refracted sunlight. Claire Barrett's elegiac camerawork here is superb.

All four films in Blandy's installation *Atomic Light* connect different kinds of fire: the fire of the sun; natural wildfires, which are gathering force and frequency as Earth's climate warms; and the atomic blast that consumed Hiroshima on 6 August 1945.

There is a personal dimension, beyond Blandy's vaunted concern for the environment. During the second world war, his grandfather was a prisoner of the Japanese armed forces in Singapore, and later lived with the knowledge that, had upwards of 100,000 of Hiroshima's civilians not perished, he might not have survived.

Bringing this together is a job of work. In *Empire of the Swamp*, a man wanders through mangrove swamps at the edge of Singapore, while Blandy reads out a short story by playwright Joel Tan. The enviro-political opinions of a postcolonial crocodile are as good a premise for a short story as any, I suppose, but the film isn't well integrated with the show.

> **"Blandy connects different kinds of fire: the sun; worsening wildfires; the atomic blast at Hiroshima"**

Soil, Sinew and Bone, a visually arresting game of digital mirrors composed of rural footage from Screen Archive South East, equates modern agriculture and warfare.

That there is a historical connection is undeniable: Fritz Haber received the 1918 Nobel prize in chemistry for the Haber–Bosch process, a method of synthesising ammonia from nitrogen and hydrogen. That ammonia, a fertiliser, can be used to make explosives is an irony familiar to any student, though it isn't obvious why agriculture should be morally tainted by it.

Alas, Blandy can't resist the sirens of overstatement. We eat, he says, "while others scratch... in the baked earth". Never mind that since 1970 hunger has more than halved in the developing world, according to the UN – only possible thanks to Haber-Bosch.

Defenders of the artist's right to be miserable in the face of history will complain I am taking *Atomic Light* too literally. I respond that I am taking it seriously. Bad faith is bad faith, however you cut it. If, in your voice-over, you dub Walt Disney's Mickey "this mouse of empire", if you use footage of a children's tea party to hector your audience about wheat and sugar, and if you cut together words and images to suggest that a jobbing farmer out shooting rabbits was a landowner on the lookout for absconding workers, you simply pile straws on the camel's back.

Thank goodness for *Sunspot*, Blandy's fourth, visually simpler film, which juxtaposes the lives and observations of real-life solar astronomers Joseph Hiscox in Los Angeles and Yukiaki Tanaka in Tokyo, who each drew the sun on the day of the Hiroshima bomb.

Here is a salutary, saving reminder that, to make art, you are best off letting the truth speak for itself. ■

Simon also recommends...

Book
After London
Richard Jefferies
Edinburgh University Press
London sank back into the swamp long ago in this superb scientific and political fantasy by nature writer Richard Jefferies.

Film
Last and First Men
Jóhann Jóhannsson
BFI Player
Tilda Swinton narrates 2 billion years of future history, adapted from Olaf Stapledon's sci-fi novel in a mesmerising art film by Jóhann Jóhannsson.

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Why is the universe just right for life?

It is a question that captivated Stephen Hawking and his final thesis contains a surprising answer – as his long-time collaborator **Thomas Hertog** explains

IT WAS common knowledge among students at the University of Cambridge that whoever obtained the best marks in the final part of the mathematical tripos exams would be summoned to see Stephen Hawking. I had just got my results and had come top. Sure enough, I was invited for a discussion with him.

I made my way to his office deep in the labyrinth of the department of applied mathematics and theoretical physics, which was housed in a creaking Victorian building on the banks of the river Cam. Stephen's office was just off the main common room, and even though it was noisy there, he liked to keep his door ajar. I knocked, paused and slowly pushed it open.

I didn't quite know what to expect on the other side of that door. I knew, of course, that Stephen was famous for his work on black holes and that he had even got into trouble for some of his ideas about what happens when they explode. But it turned out that he was musing on a different question: why is the universe just right for life to arise?

Pondering this question would turn into a long quest for us both. For the next two decades, until his death, Stephen and I worked shoulder to shoulder on novel ideas that suggest a radically new understanding of why the universe is the way it is. In our conception, the laws of physics themselves have, in a sense, evolved to be the way they are.

In that first meeting, in June 1998, I found Stephen sitting behind his desk with his head leaning against a headrest on his wheelchair. The office window was open and I later learned that he liked to keep it that way at all times, even in freezing weather. On one of the blackboards were equations that appeared to date from the early 1980s. I wondered if they might be his last handwritten scrawls.

"The universe appears designed," he said through his speech synthesiser. He continued: "Why is the universe the way it is?" None of my physics teachers had asked questions like this before. "Isn't that a philosophical matter?" I tried. "Philosophy is dead," Stephen replied, his eyes twinkling.

BRETT RYDER

He was a master of packing a lot into a few choice words. When he spoke of the universe being designed, he was referring to the observation that, of all the universes that could exist, ours is spectacularly well configured to bring forth life. What to make of this has bedevilled thinkers one way or another for centuries. Yet it is only fairly recently that we have discovered how deep these waters run.

The universe's biofriendliness, it turns out, concerns the laws of physics themselves. There are numerous features in these laws that render the universe just right for living things. Twiddle ever so slightly with any of these and habitability would often hang in the balance.

Take the Higgs boson, which weighs as much as 133 protons. This may sound heavy (for a particle), but it is 100 million billion times lighter than many physicists would consider a natural mass. The Higgs boson couples to other particles of matter and, in this way, imbues them with mass, but these couplings also add to the Higgs's own mass, so you would expect it to be a far weightier beast. The unbearable lightness of the Higgs is crucial for life, however, for a light Higgs keeps electrons, protons, neutrons and so on light as well. That, in turn, ensures that the building blocks of life, such as DNA, proteins and cells, don't collapse under the force of gravity.

Or consider the expansion of the universe. In 1998, cosmologists discovered that the expansion of space has been accelerating for about 5 billion years. The cause of this acceleration is often attributed to something known as vacuum energy, which is predicted by quantum theory. But the density of vacuum energy seems to be 10^{120} times lower than physicists expect based on theory. If the vacuum energy density of the universe were just a tad larger, however, its repulsive effect would be stronger and acceleration would have kicked in much earlier. This would have meant that matter was so sparsely distributed that ›

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it couldn't clump together to form stars and galaxies, once again precluding the formation of life.

The laws of physics and cosmology have many more such life-engendering properties. It almost feels as if the universe is a fix – a big one. Traditionally, most scientists regarded the mathematical relationships that underpin the laws of physics as transcendental Platonic truths. In which case, the answer to the riddle of cosmic design – to the extent that it is an answer – is that it is a matter of mathematical necessity. The universe is the way it is because nature had no choice.

Laws of the multiverse

Around the turn of the 21st century, an entirely different explanation emerged. This one had its roots in a series of surprising discoveries that suggested that at least some properties of the physical laws might not be carved in stone, but could instead be the accidental outcome of the particular manner in which the early universe cooled after the big bang. From the species of particles to the strength of forces to the amount of vacuum energy, it became apparent that the universe's biofriendly laws were forged in a series of random transitions during its earliest moments of expansion. Reasoning along these lines, cosmologists started wondering whether, perhaps, there was more than one universe. Maybe we live in a multiverse, an enormous, inflating space with a variegated patchwork of universes, each with its own big bang, leading to its own local physical laws.

This led to a sweeping change of perspective on the idea of our universe being fine-tuned for life. Even though most universes would be sterile, in some, the laws of nature are bound to be just right for life. String theorist Leonard Susskind once likened the local character of physical laws in the multiverse to the weather on the US east coast: "Tremendously variable, almost always awful, but lovely on rare occasions." In his view, our delightful cosmic weather is a fluke and the impression of design is an illusion.

All this was very much on Stephen's mind when I first walked into his office in 1998. I could sense he wasn't keen on the idea of a multiverse. Before long, I was collaborating with him to try to find a better answer, first as his PhD student and later as his colleague.

Stephen's reticence to embrace the multiverse grew stronger in the early 2000s, when it became clear that it didn't actually explain anything. In multiverse cosmology, there are "metalaws" governing all the universes. But these metalaws don't specify in which of the habitable universes we are supposed to be. This is a problem, for without a rule that relates the metalaws of the multiverse to the local laws within our universe, multiverse musings get caught in a spiral of paradoxes that leaves us without verifiable predictions. Multiverse cosmology is like a debit card without a PIN or an IKEA flatpack closet without a manual: useless.

Can we do better? Yes, Stephen and I found out, but only by relinquishing the idea, inherent in multiverse cosmology, that our theories can take a God's-eye view, as if somehow standing outside the cosmos. It is an obvious and seemingly tautological point: our cosmological theory must account for the fact that we exist within the universe. "We are not angels who view the universe from the outside," Stephen began to preach. So we set out to rethink cosmology from an inside-out, observer's perspective. This, we soon discovered, required adopting a quantum outlook from within the universe.

The key role of the observer has been recognised since the discovery of quantum theory in the 1920s. Before a particle's position is observed, there is no sense in even asking where it is. It doesn't have a definite position, only possible positions described by a wave function that encodes the likelihood that the particle, if it were observed, would be here or there. Of course, quantum observations are by no means restricted to those made by humans. Such observations could be made by a dedicated detector, by the environment or even through interaction with a lone photon.

Stephen and I came to understand what went on in the early universe as a process akin to that of natural selection on Earth, with an interplay of variation and selection playing out in this primeval environment. Variation happens because random quantum jumps cause frequent small excursions from deterministic behaviour and occasional larger ones. Selection enters the picture because some of these excursions, especially the larger ones, can be amplified and frozen-in thanks to quantum observation. This then gives rise to new rules that help shape the subsequent evolution.

The interaction between these two competing forces in the furnace of the big bang produces a branching process – somewhat analogous to how biological species would emerge billions of years later – in which dimensions, forces and particles first diversify and then acquire their effective form when the universe expands and cools.

And just like in Darwinian evolution, this introduces a subtle backward-in-time element



COURTESY OF THOMAS HERTOG

Thomas Hertog (left) collaborated with Stephen Hawking for many years

> “The upshot of all this is a profound revision of what cosmology is ultimately about”



The universe is so well suited to life that it can appear designed

to our hypothesis. It is as if the collective quantum observations retroactively fix the outcome of the big bang. For this reason, Stephen liked to refer to our idea as “top-down cosmology”, to drive home the point that we read the fundamentals of the universe ex post facto, somewhat like how biologists reconstruct the tree of life. “We create the universe as much as the universe creates us,” he once told me. When *New Scientist* covered our idea in 2006, it was described as a “reverse choose-your-own adventure”.

Walking on quicksand

In hindsight, we were walking on quicksand back then in the sense that we didn’t quite have a solid mathematical basis for our ideas. As we began to look for firmer ground, inspiration came from an unexpected corner. Around that time, another revolution in physics was picking up, one that was all to do with holography. This would prove to be just what we needed.

A normal hologram encodes all information about a three-dimensional object on a two-dimensional surface. In a sense, the third dimension emerges from the surface when we look at it. The first inklings that even the force of gravity may have holographic roots go back to work in the 1970s by Stephen and, separately, Jacob Bekenstein. They discovered that all there is to know about the interior of black holes can be encrypted on their event horizon surface.

Then, in 1997, physicist Juan Maldacena went further and envisaged that the entire universe may be akin to a hologram. He showed that a system of quantum-entangled particles located on a surface can contain within it all the information of a higher-dimensional cosmos with gravity and curved space-time. Soon, holography became the talk of the town among theoretical physicists, who saw in it a promising way to finally get Albert Einstein’s general relativity, his theory of gravity, to work with quantum theory.

At first, the kind of universes generated by holographic theory bore no resemblance whatsoever to the expanding universe we live in. However, starting in around 2011, Stephen and I figured out how to apply the cosmos-as-hologram idea to describe the earliest stages of an expanding universe like ours. In this cosmological setting, it turns out it is the dimension of time that holographically pops out. History itself is holographically encrypted.

What’s more, time emerges in the ex post facto manner that we had envisioned. The past is contingent on the present in holographic cosmology, not the other way around. In a holographic approach to cosmology, venturing far back in time means taking a fuzzy look at the cosmological hologram. It is like zooming out, an operation whereby we discard more and more of the entangled information that the hologram encodes. Holography suggests that not only time, but also the physical laws that shape our universe, disappear back into the big bang. This is very different to the old Platonist view that the laws of nature are somehow immutable. Stephen and I held that it isn’t the laws as such that are fundamental, but their capacity to change.

The upshot of all this is a profound revision of what cosmology is ultimately about. For almost a century, we have been studying the history of the universe against a stable background of fixed laws of nature. But the quantum outlook that Stephen and I developed reads the universe’s history from within and as one that includes, in its earliest stages, the genealogy of the physical laws.

It is a radical idea, for sure, but one that may, in time, become testable. Some ideas to do with the early universe can be tested by deciphering the cosmic microwave background (CMB) radiation, the flood of light released 380, 000 years after the big bang. But the primeval evolution we envisage unfolded before that, meaning it is hidden far behind the CMB. We are in a situation not unlike Charles Darwin in the 19th century, who had only scant fossil evidence for his grand new hypothesis.

But I am hopeful this won’t be the case forever. We are witnessing a revolution in gravitational wave astronomy and these waves can reach us from well before the CMB era. Future observations of primeval gravitational waves should enable us to probe the universe’s earliest phase.

An entirely different path to test our ideas has to do with holography. Already, quantum experimentalists are attempting to create strongly entangled quantum systems, made up of trapped atoms or ions, that holographically encode some of the properties of black holes or toy-model universes. By experimenting with these systems, we can hope to learn more about what sort of entanglement patterns underpin gravity and the fabric of space-time. We might also be able to see whether the origin of time happens in the specific way Stephen and I envisaged. That would amount to an experimental practice of early universe cosmology.

Turning cosmology inside out and upside down was a quintessentially Hawkingian act. For Stephen and I, inspired by the paradoxes of the multiverse, it was a way to get a grip on the appearance of cosmic design. If this new thinking turns out to be right, it may yet prove to be his greatest scientific legacy. ▮



GERT VERBELEN

Thomas Hertog is a cosmologist at KU Leuven, Belgium. His book *On the Origin of Time: Stephen Hawking’s final theory* is out next month

The people's vet

Gladys Kalema-Zikusoka set out to help gorillas by improving the health of their human neighbours. As she tells Graham Lawton, the results speak for themselves


JO-ANNE MCARTHUR

WHEN Gladys Kalema-Zikusoka became Uganda's first wildlife vet in 1995, there were just 650 wild mountain gorillas in the world, 300 of which were in Bwindi Impenetrable National Park in south-western Uganda. The species as a whole was critically endangered and the future looked bleak.

Then Kalema-Zikusoka had an idea. At just 25 years old, having recently graduated from London's Royal Veterinary College, she recognised that three major threats to the gorillas – disease, habitat loss and poaching – could be tackled by improving the health and well-being of local people. This approach was highly unusual at the time, but is now seen as a model of conservation practice globally.

In 2003, she left the Ugandan Wildlife Service to become founder and chief executive officer of non-profit organisation Conservation Through Public Health. She has spent the past 20 years conserving mountain gorillas in Bwindi, and populations are on the rise. Her memoir, *Walking With Gorillas*, will be published on 13 April. She spoke to *New Scientist* about her life and work.

Gorillas are vulnerable to many of the diseases that affect their human neighbours



BELLA FALK/ALAMY

Left: Tourism raises vital funds for conservation

Below: Gladys Kalema-Zikusoka has studied gorillas for over 20 years



KIBUUKA MUKISA/UNEP

"You cannot conserve wildlife in isolation when people are so poor"

Graham Lawton: How did you get the job as Uganda's first wildlife vet straight out of veterinary college?
Gladys Kalema-Zikusoka: Whenever I came home on holidays from college, I worked with wildlife. I worked in Budongo Forest, where I did my very first study on wildlife, looking at parasites in the faecal samples of chimps. Two years later, I went to Bwindi and I studied mountain gorillas.

I thought, I would like to do this full-time. So, I sent a report to the executive director of the National Parks. I told him, I think you need a vet, and he surprised me. He said: "We're thinking of hiring a vet. Your job is waiting for you!" I'm like, what!? So, I came back to Uganda and taught myself how to treat the wildlife.

What was the first wildlife illness that you tackled?
One of my first cases was when the gorillas in Bwindi got scabies. They were losing their hair and developing white, scaly skin. I went to a human doctor friend of mine and I asked, what's the most common skin disease in people? And she's like, it's scabies. It's very common in low-income groups of people who don't have good hygiene.

So, I went to the gorillas with some ivermectin, which is good for treating scabies. We were able to treat the gorillas, but a baby was dropped by her mother because she was already too far gone and she died. The baby had pneumonia because she had lost almost all of her hair.

How do gorillas catch scabies from humans?
People put dirty clothing on scarecrows to chase away gorillas and other wildlife and we think the gorillas were picking it up by touching the clothing, because nobody was touching the gorillas in those days.

Scabies was pretty common in the local communities, so people said, we need to improve community hygiene because the gorillas are just going to keep picking up things. Not just scabies: there's open defecation, so they could pick up cholera or typhoid. People don't cover their rubbish heaps. I was the only vet in the Uganda Wildlife Authority at the time, so everyone was looking at me.

How did you help local communities and gorillas?
We developed a team of health workers who go to people's homes to talk about hygiene, sanitation, nutrition, sustainable agriculture. We did a lot of hygiene education: wash clothes, cover your rubbish heaps, have toilets.

We went beyond wildlife health and started looking at habitat protection. We talk about conservation issues, about why gorillas are important, why local people should protect the forest and how to prevent zoonotic disease. Some of the team were taught to give injections for family planning.

Why the focus on family planning?
USAID (the US Agency for International Development, which promotes contraception to reduce poverty and to aid conservation) approached us and said, we love what you're doing around Bwindi, can you add family planning? First of all I was reluctant, but then I realised that many people had many children – some can have 10 children.

Half of the kids go to school and the other half are staying at home to chase wildlife from the garden. The ones who don't go to school don't have a future because the whole cycle of poverty doesn't end. All they can do is dig in the garden and go to the forest to poach. And there are too many of them, so they can't get proper healthcare. So gorillas would get sick.

We did a survey. A lot of women didn't want to be having all these kids, they wanted contraception.

When you go to a village where people are in poverty, is it difficult to convince them to value wildlife, when they are often in conflict with it?
It is a difficult conversation to have when people are so poor and a gorilla has just destroyed their banana plant. But if they are benefiting from living next to wildlife, they ›



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L: RYOMA OTSUKA; R: T. MARENT/MINDEN PICTURES/ALAMY



CTPH

Above, clockwise: Bwindi Impenetrable National Park, Uganda; Gorillas live in close family groups

Left: Research into gorilla disease is ongoing

can tolerate wildlife better. The fact that we're improving their healthcare was a very good way to break the ice because we show them that we care about them as well, not just the wildlife.

One Health, the conservation concept that the health of people, animals and ecosystems are connected, sounds similar to what you are doing. Did you invent it?

Conservation Through Public Health was one of the very first organisations in the world to do One Health, but we didn't call it One Health at the time. We realised that to make sure wildlife stays healthy, we have to improve the health of people who interact with it. And to ensure that people stay healthy, you have to make sure they're not getting diseases by poaching wildlife, and through the bushmeat trade.

Tell me about your success.

We've seen that community health is improving, gorilla health is improving. Many more people have pit latrines, they have hand washing stations – basic hygiene. The gorillas are falling sick less often; they haven't had a scabies outbreak since 2002. They're picking up fewer human diseases as a direct impact of our work, and gorillas are increasing in number.

Can you put a figure on the increase in gorilla numbers?

When I participated in the first census in Bwindi in 1997, there were only 650 mountain gorillas in the world, 300 in Bwindi and 350 in Virunga National Park, in neighbouring Democratic Republic of the Congo (DRC). Now, the number has gone up to more than 1063. This is the 2018 figure. In the next census, we expect to see even more than that.

Mountain gorillas have been moved from critically endangered to endangered by the IUCN (International Union for Conservation of Nature), because they're showing a positive growth trend. All the other gorilla subspecies are going down.

The recent Ebola outbreaks in Uganda and DRC are thankfully now over. If Ebola did get into gorillas, what would happen?

The gorillas would die very quickly. Gorillas and chimpanzees in the Central African Republic got Ebola. They died, and so did the people who ate them. Over 5000 western lowland gorillas have died of Ebola over the past 25 years. So if it got into the gorillas in Bwindi, it would be terrible.

Was covid-19 a threat to the gorillas?

We were very worried during the pandemic. We were able to get people to wear masks. Respiratory diseases went down through mask wearing and now people need to continue wearing them.

Unfortunately, because of the lack of tourism during covid-19, a silverback gorilla called Rafiki was killed by a hungry bushmeat poacher. This poacher had set up snares and when he speared a bush pig, it screamed and Rafiki got scared, charged and was speared.



KIBUUKA MUKISA/UNEP

Gladys Kalema-Zikusoka's interventions have helped mountain gorilla populations to recover in Uganda

"People poach because they are hungry. They don't want to harm the gorillas"

The poacher was put in jail for 11 years, and now everyone knows that if you kill a gorilla, you can go to jail for a long time. That never used to be the case. Before it was, like, oh, kill a gorilla, bribe your way out of jail in a few weeks.

How else are you tackling poaching?
We provide seedlings of crops that grow quickly to all the vulnerable communities living around the park: cabbages, maize, groundnuts, beans, pumpkins, kale. We plant trees in gardens so that people don't have to go into the forest for firewood.

People poach because they are hungry. If you can address hunger, then you can reduce the need for people to enter the park to poach. People do it because they're desperate. They don't want to harm the gorillas.

Does the model that you pioneered for gorillas work for other species?
The great ape model is the most direct because people can make gorillas and chimpanzees sick. But anywhere there's poor people and critical biodiversity, I think this model can work. Someone told me that they thought it would work really well with tigers in India.

What is next for Conservation Through Public Health?
We would like our approach to be scaled up in other places. We are working closely with a lot of NGOs in conservation and healthcare who would like to adopt the model. We would like to focus on areas where gorillas are found. We feel that the model can be spread to other countries – Kenya, Tanzania.

Another area that we're focusing on is preventing irresponsible tourism. Even before covid, gorillas were getting too close to tourists and tourists were getting too close to gorillas. We talk to the rangers about how to manage the tourists, even the difficult ones, so they don't get too close. They still break the rules. The gorillas break the rules even more! But we are much stricter about it.

What needs to happen in conservation in general?
I think, as conservation groups, we have to get much more sensitive about the fact that communities have to be doing well before wildlife is to do well. I think more and more groups are noticing it and more and more conservation donors are noticing it too. You cannot conserve wildlife in isolation when the people living next to it are so poor. ∎



Graham Lawton is staff writer at *New Scientist*

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2 O W

3 N E X T

4 Y E A R

5 D E C A D E S

6 A W A Y

7 C E N T U R I E S H E N C E

8 M I L L E N N I A I N T H E F U T U R E

9 T H E F A R

10 D I S T A N T F U T U R E

Far-sighted thinking

Our tendency to focus narrowly on the now lies behind the most serious problems we face. How can we embrace the long-term perspective, asks **Richard Fisher**

IN 1981, Kent Cochrane was in a motorcycle crash that left him with an unusual brain injury, one that transformed his perception of time. Later, he was visited by psychologists. "What will you be doing tomorrow?" one asked. "I don't know," Cochrane replied. "Do you remember the question?" the psychologist said. "About what I'll be doing tomorrow?" "Yes. How would you describe your state of mind when you think about it?" Cochrane paused. "Blank, I guess."

The psychologists realised that Cochrane couldn't form a mental picture of any time outside his present. When asked how that felt, he described it as "like swimming in the middle of a lake. There's nothing there to hold you up or do anything with."

Cochrane had lost the faculty of mental time travel: the ability to transport the mind to the past or future. We are lucky to have this talent. It means we can remember our best experiences and make detailed plans for tomorrow. It may even have supercharged humanity's evolutionary success. Yet it is an imperfect skill. We can still get stuck in the present, distracted by the near-term. So why do we struggle to take a long-term perspective?

For the past five years, I have been trying to answer this question while researching a book called *The Long View*. I argue that societies are in danger of becoming "time-blinkered", which is worse than simple short-termism: it is a present-focused view so embedded that it goes unnoticed. The good news is that we can escape this trap – if only we understand the factors that shape how we think about time.

In recent years, researchers from diverse fields have converged on the idea that short-termism is now a significant problem in industrialised societies. The inability to engage with longer-term causes and consequences underpins some of the world's most serious problems: climate change, biodiversity collapse, antibiotic resistance, income inequality, the risk of nuclear war, and more. The historian François Hartog argues that the West has entered a period where "only the present exists, a present characterised at once by the tyranny of the instant and by the treadmill of an unending now".

It is well established that people have a bias towards the present, focusing on salient attractions in the moment at the expense of the health, well-being and financial stability of their future selves, community or descendants. In business and finance, this bias surfaces as short-sighted corporate decisions. In politics, it is the way governments ignore the lessons of history and the future consequences of their policies. And on slow-burning problems like climate change, it manifests as the unwillingness to make small sacrifices today that could make a major difference tomorrow. Instead, all that matters is next quarter's profit, winning the election or sating some other near-term desire.

These time-blinkered perspectives cannot be blamed on one single cause. It is fair to say, though, that our psychological biases play a major role. I call these "temporal habits".

People's reluctance to delay gratification is the most obvious example, but there are others. One is the "availability heuristic", which describes how the most accessible information in the present skews decisions about the future. For instance, you might hear someone say: "It's cold this winter, so I needn't worry about global warming". Another is "salience bias", where loud and urgent distractions seem disproportionately important, nudging people to ignore longer-term trends that arguably matter more. This is when the tweets of Elon Musk draw far more attention than, say, gradual biodiversity decline.

The human mind is bad at noting slow change. As the Harvard psychologist Daniel Gilbert once quipped, if invading aliens wanted to weaken humanity, they wouldn't send ships, they would invent climate change. Indeed, when it comes to creeping environmental transformations, we can develop a form of collective amnesia called "shifting baseline syndrome". It is so named because each new generation can believe the state of affairs they encounter is nothing out of the ordinary. Older people today, for example, can remember a time with bug-splattered car windscreens after long drives. Children, on the other hand, have no idea that insect abundance has plummeted.

A final, subtle temporal habit involves the words we use to describe the past or future. In English and other languages, we talk about the longer-term future as being "far" or "distant", as if it were a foreign land. The psychologists Nira Liberman, now at Tel Aviv University in Israel, and Yaacov Trope at New York University say that this has a psychological distancing effect, meaning people become less concerned about the details of what happens there.

In their original 2008 paper on the phenomenon, the pair used *Landscape With the Fall of Icarus*, Pieter Breugel the Elder's 16th-century painting, to highlight this discrepancy. In the foreground, a farmer ploughs on, ›

ignoring the death of Icarus in the background, his legs flailing in the ocean. The physical distance makes his plight less tangible. Map this onto people's attitudes to climate change, and it is easier to see how future consequences get ignored. If it is "far", as in over the horizon, then it is less salient. The future, however, isn't distant at all: our grandchildren may well live in the same city or country as we do – and certainly will inherit the same planet.

None of these temporal habits would be impossible to mitigate if brought into the open. However, they have also been amplified by a host of subtle incentives and deterrents that collectively discourage the long view. I call these "temporal stresses".

Let's consider one example, from the business world. In the early 20th century, the New York Stock Exchange made a seemingly reasonable request of listed companies: every three months, they would share updates with the market. By 1931, 63 per cent of firms had complied. This was quarterly reporting, a temporal invention that has discouraged a long view among corporate leaders ever since. Studies suggest quarterly reporting correlates with reductions in R&D spending, patents and hiring – all things that can bring longer-term prosperity, albeit at short-term cost. "I'm confident: when firms are forced to increase reporting frequency, they cut back on investments," says Arthur Kraft at City, University of London. He blames two things: "discipline" and "myopia". Discipline is where leaders are punished by the financial market for taking a long-term view. Myopia is self-inflicted: pre-emptively taking short-term decisions to please investors.

It isn't hard to find more case studies where people in business took ill-advised shortcuts to satisfy targets. Historian Jerry Muller, professor emeritus at the Catholic University of America in Washington DC, calls this "metric fixation". To illustrate that the problem goes far beyond business, he points out that when New York introduced scorecards for cardiologists, which publicised their surgery mortality rate, many doctors stopped operating on sicker, riskier patients.

Bad incentives also drive short-termism in politics. In my book, I tell the story of David Stockman, a member of US president Ronald Reagan's administration who got himself into hot water in the 1980s over his unwillingness to support a social security reform that would have played out over many years. Instead, he favoured short-term cuts, and he was transparent about his reasons. "I'm just not going to spend a lot of political capital on some other guy's problem in 2010," he told reporters. The truth is there are few upsides for politicians to make costly sacrifices that benefit future administrations. And in an age of social media and 24-hour news, populism thrives. As former European Commission president Jean-Claude Juncker once said about political decisions: "We all know what to do, we just don't know how to get re-elected after we've done it."

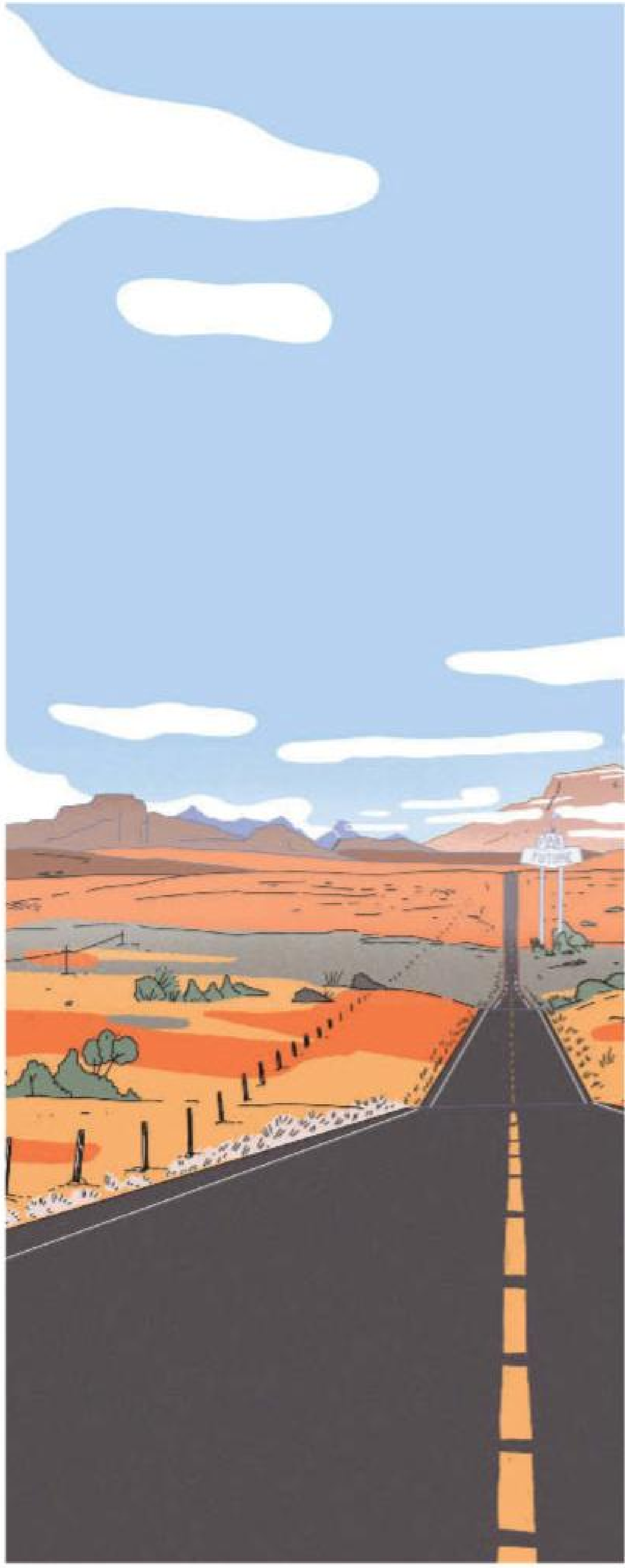
Long-mindedness

At this point, we could be forgiven for feeling despondent. It seems difficult to see how these temporal habits, and the stresses that exacerbate them, might be broken. Yet various studies suggest that it is possible to encourage a longer perspective. Based on this research, I argue that we each have a "timeview" – a way of thinking about our place within the past, present and future that defines our priorities and decisions. Some individuals are more long-minded than others, and some societies and cultures too. But timeviews aren't fixed.

Consider the inability to delay gratification. In 2017, Bettina Lamm at the University of Osnabruck in Germany and her colleagues invited two sets of children from Germany and Cameroon to take the famous marshmallow test, where participants must choose between eating one immediately, or holding out for two. Lamm found the Cameroonian children, from a rural farming community, were more likely to wait for a second marshmallow than the German kids. Another study found that children in the test were more likely to show restraint when asked to wear a green shirt and told that green-shirt wearers wait for their marshmallows. These studies suggest that social circumstances can foster a longer view.

This dovetails with the research of the late Geert Hofstede, a psychologist who was at Maastricht University in the Netherlands, and who showed that more individualist nations, like the US or Australia, have less of a long-term orientation than collectivist societies like Japan or China. Hofstede's descriptions are broad brushstrokes, maybe even stereotypes, but he nonetheless argued that his surveys reflect a country's dominant cultural norms.

Whereas Japanese people might tend to "see their life as a very short moment in a long history of mankind", for example, people in the



MARCOS MONTIEL

"A host of subtle incentives and deterrents discourage long-term thinking"



US are more likely to prioritise other guiding frameworks, such as "liberty and justice for all". This US mindset has many positives, but it may have fostered a free-market culture that enabled corporate short-termism to develop unchecked. Japan, by contrast, is known for a business culture that places more emphasis on longevity and tradition.

There is also tentative evidence that some languages encourage a longer view. It is far from established that language can direct people's thoughts, as some have claimed – but it does ask us to express concepts in different ways, possibly steering cultural norms. People whose tongues have a weak future tense – such as German, Japanese, Mandarin and most of the Scandinavian languages – talk of the future as closer. So, to describe tomorrow's weather in Mandarin, you would say *míng tian xia yu* – "tomorrow fall rain", not "tomorrow it will rain", which is a strong future tense. A decade ago, economist Keith Chen at the University of California, Los Angeles, found that weak future speakers were 31 per cent more likely to put money into savings, had accumulated 39 per cent more wealth by retirement and were 29 per cent more likely to exercise.

Subsequent research has described a correlation with pro-environmental behaviours, while other studies revealed that corporations led by speakers who use a weak future tense displayed a greater willingness to save and to invest in R&D. It is possible that other cultural differences played a role, but the correlation has been observed in a number of studies. For example, in one clever study that revealed this pattern, weak and strong future speakers lived side by side in a bilingual Italian town amid similar economic circumstances.

Shifting perspectives

Even within a single culture, nation and language, some people are more or less present-focused than others – and this may be a learned behaviour. Using a test called the Zimbardo Time Perspective Inventory, the psychologist Philip Zimbardo at Stanford University in California, and his colleague John Boyd, identified striking differences between timeviews on the individual level, which he and other researchers have since shown can influence people's outlook and life choices. Some people are more past-oriented, some present-focused and others are more future-motivated. (You can discover your own weighting on thetimeparadox.com.)

Very broadly, people with a pronounced future perspective are more likely to be forward-planners, to floss and eat healthily, to do well academically and to embrace pro-environmental attitudes. Past-oriented people are more likely to be (small-c) conservatives, concerned with maintaining tradition or family values. Finally, present-oriented people are, obviously, strongly influenced by what they do and experience in the moment.

Zimbardo also showed that our timeviews can be coloured by optimism or pessimism. So, for example, people scoring high on "present-hedonism" in the inventory are more focused on near-term pleasures, while a strong "present-fatalism" result implies a lack of agency: a doomist outlook that can lead to apathy and hopelessness.

Importantly, we can change our time perspective. People given mindfulness training reduced their present-fatalism scores. Researchers have also boosted people's future perspective by asking them to write what they would want said about themselves in their eulogy, or to imagine being 90-years-old, in a rocking chair, reflecting on their life choices.

This "perspective taking" seems to be a powerful way of fostering a longer view. The idea is to encourage people to mentally time travel to reflect on the experience of specific individuals in the past or future – themselves or others. When economist Tatsuyoshi Saijo at Kochi University of Technology, Japan, asked people to interact with someone role-playing as an "imaginary future person" or to dress ceremonially as citizens of the year 2060 while discussing political policies, they were subsequently more empathetic and generous towards future generations. Likewise, when other researchers asked people to reflect on what past generations had sacrificed – fighting wars or enduring hardship, for instance – they were more likely to feel a sense of moral obligation towards future generations.

Unlike Kent Cochrane after his accident, we have the remarkable ability to move our minds between the past, present and future. But to use this faculty to its full extent, we might take a cue from geologist Marcia Bjornerud at Lawrence University in Wisconsin, who writes of the importance of "timefulness". She defines this as the "acute consciousness of how the world is made by – indeed, made of – time".

Viewing the world through such a temporal lens could help us heed the lessons of history, navigate the most serious challenges we face today and look ahead to possible futures with greater clarity, generosity and even hope. Ultimately, if we want to chart a route out of our tumultuous century – steering our fate rather than stumbling into tomorrow – we need to unlock a longer view. ■



Richard Fisher is author of *The Long View: Why we need to transform how the world sees time*, out on 30 March, and a senior journalist for *BBC Future*



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The science of cooking

When life gives you lemons

The flavour of fresh lemon is delicious, but this citrus fruit becomes even tastier when it is preserved in salt, says **Sam Wong**



Sam Wong is assistant news editor and self-appointed chief gourmand at *New Scientist*. Follow him @samwong1

What you need

8 unwaxed lemons
100 grams salt
50 grams sugar
A jar

IS THERE any fruit more useful than a lemon? The citric acid in its juice can provide a touch of sharpness that improves a vast range of dishes. The fragrant oil concentrated in the peel of lemons has an aroma so appealing that we add it to cleaning products. It is also a good source of vitamin C: once its power to prevent scurvy was discovered in the 1750s, it led to a boom in demand for lemons.

The family history of citrus fruits is complex and uncertain, but genomic studies suggest that lemons are a hybrid of a sour orange and a citron, another citrus fruit that resembles a large, knobbly lemon. From South Asia, they made their way to Europe and North Africa in the Middle Ages.



THE PICTURE PANTRY/ALAMY

The fruits are usually green when harvested. As they ripen, the green chlorophyll pigment breaks down, revealing the carotenoid pigments that make them yellow.

Lemon juice contains about 2.5 per cent sugar, but its sweetness is masked by the sourness from citric acid, which makes up about 5 per cent of the juice. The aroma of lemons comes largely from a family of volatile compounds called terpenes, including limonene, citral and pinene. We associate lemons with sourness so strongly that a non-sour lemon extract can increase people's perception of sourness.

Although the flavour of the fresh fruit is so useful in cooking, it develops into something even more wonderful when lemons are preserved in salt. This has been done in North Africa for at least 800 years: the oldest known recipe is from a 12th-century Egyptian physician named Ibn Jumay.

As in other preserves, such as sauerkraut and kimchi, salting inhibits the growth of microbes that cause spoilage, instead favouring harmless salt-tolerant bacteria and yeasts. Over time, the peel softens and loses its bitterness.

Most lemons found in shops are coated in wax to extend their shelf life. The wax is safe for consumption, but it is best to use unwaxed lemons for preserving, or to scrub off the wax.

Slice off the very top and bottom of the lemons. Make two cuts lengthwise in each fruit so that it is almost split into quarters, but leave these attached at one end. Mix the salt and sugar, then stuff this into the lemons and pack them into a jar, with as little space as possible. Leave at room temperature. After one or two days, once some fluid has been drawn out of the lemons, you should be able to squash them into the jar a bit more. If needed, add some juice from more lemons to ensure they are fully submerged.

They are ready to eat after about a month. After that, you can keep them in the fridge for up to a year. Rinse off the brine before using, then chop finely and add them to any dish that would benefit from a lemony kick. ■

The science of cooking appears every four weeks. Share your cooking successes with us on Twitter and Instagram @newscientist, using the hashtag #NewScientistCooking

Next week

Stargazing at home

These articles are posted each week at **newscientist.com/maker**



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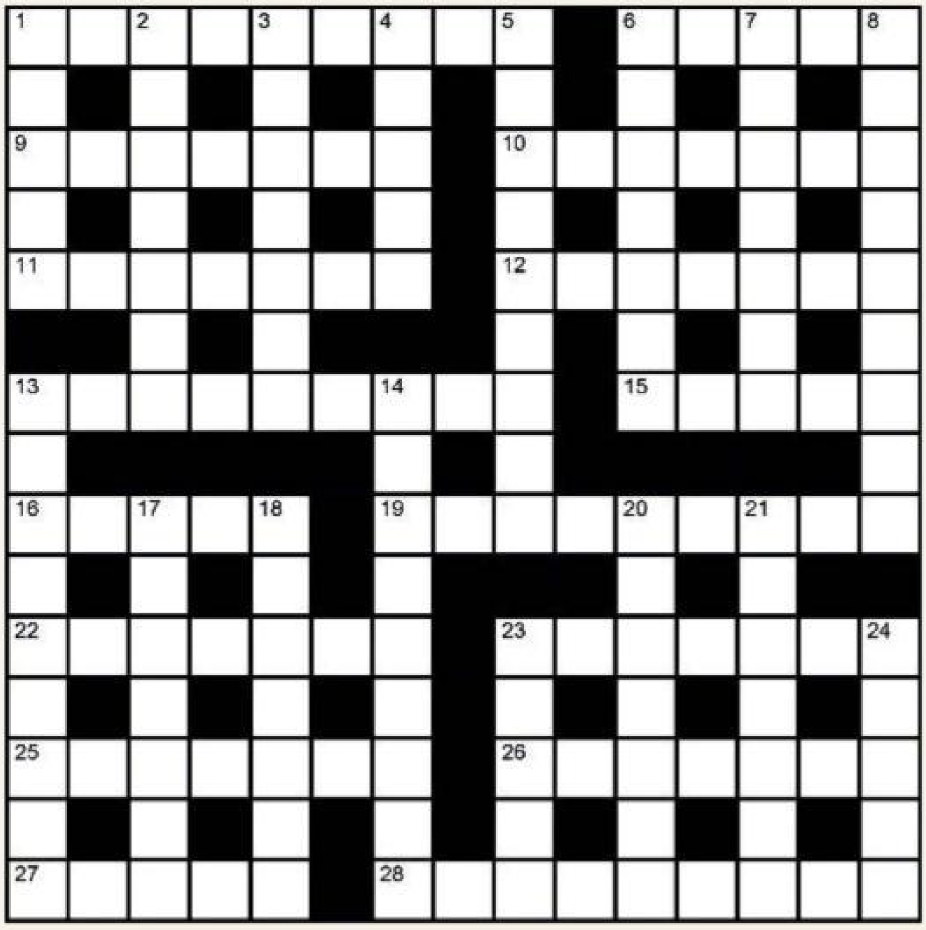
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Quick crossword #129 *Set by Richard Smyth*



Scribble zone

Answers and the next cryptic crossword next week

ACROSS

1 Calcium oxide (9)
6 Flowering shrub in the genus *Syringa* (5)
9 Meteor associated with Halley's comet (7)
10 Remove water (from a ship, say) (4,3)
11 London electronic music band (3,1,2,1)
12 Outer tip of the spar on a ship's mast (7)
13 Landrail, *Crex crex* (9)
15 Trailing vine also called Chinese arrowroot (5)
16 Grass cutter (5)
19 Clotting agent (9)
22 Bone case in the mammalian thorax (3,4)
23 Weasel genus (7)
25 ρ (7)
26 Satnav system launched in 2016 (7)
27 Ahead of time; nearer the beginning than the end (5)
28 Of an orbit, non-circular (9)

DOWN

1 Specified quantity; allotment; ration (5)
2 Type of support beam (1-6)
3 Concerned with motion (7)
4 Forefinger (5)
5 Disease of the lungs (9)
6 Jean-Baptiste ___, French evolutionist (7)
7 Spotted feline (7)
8 Cougar (9)
13 City of MIT (9)
14 Pattern; model (9)
17 Online meeting or symposium (7)
18 "Mathematics are and can only be a tool to explore ___" – Maurice Allais (7)
20 ∪ (7)
21 ___ tissue, pliable connective structures within the body (7)
23 Informal term for deceptively complex coding (5)
24 Lifeless (5)

Our crosswords are now solvable online
newscientist.com/crosswords

Quick quiz #194
set by Bethan Ackerley

1 A fertilised egg cell is also known as what?

2 The fossil specimen Turkana Boy is a nearly complete skeleton from which hominin species: *Homo ergaster*, *Homo heidelbergensis* or *Homo habilis*?

3 Who is credited with discovering thorium?

4 What is the only prime number that is the sum of four consecutive prime numbers?

5 What is the name of the process by which a massive celestial body bends the path of light around itself?

Answers on page 55

Puzzle
set by Mary Ellis

#214 Seven up!

My burglar alarm won't stop beeping. I need to enter the four-digit code, but I just can't remember what it is.

I do remember that I chose a number that is divisible by 7. I also know that I chose a number in the thousands. I recall that the numbers formed by the first three digits and the last three are divisible by 7 as well. I also deliberately chose four different digits. Finally, I know that if I add all the digits, their sum isn't divisible by 7, but if I add the digits of that sum, the result is divisible by 7.

Can you help me work out what my code is to stop the incessant beeping?

Solution next week



BIOSPHOTO/ALAMY

Whales grow to huge sizes, so why don't other marine animals do likewise?

This week's new questions

Whale of an issue **Why do no other aquatic animals grow to a huge size like whales do?** ***Justin Baker**, Melbourne, Australia*

Renewable loss **Does harvesting renewables like solar and wind change the planet slightly? Is there a tipping point where this harvesting becomes as harmful as the effect of fossil fuels?** ***Christine Wolak**, Dublin, California, US*

Rolling dilemma

Which is the best way to put a roll of toilet paper onto the holder: rolling towards you or away?

Oksana Kornilova
London, UK
Definitely rolling away if you have a cat or a toddler. I am speaking from personal experience.

Joe Gray
Norwich, Norfolk, UK
Rolling towards you requires slightly less reaching. However, if you have young children, rolling away is best, since a mischievous downward spin will just leave the roll rotating. If the roll is turned towards you, this action causes a lot of paper to be unspooled.

Ron Dippold
San Diego, California, US
I used to be a big fan of rolling away and I still think it looks nicer. But when I injured my arm and was effectively one-handed, I found that rolling towards myself was far easier. You hold the roll with your pinky and use your index finger and thumb to rip the sheets apart. So, I still roll towards myself, since it is handy while reading *New Scientist* on the loo.

However, if you own cats then rolling away from you – with the end not dangling – makes it far less likely that the paper will end up in a pile on the floor.

"You can argue over the feng shui of toilet roll positioning, but there is a more critical microbiological concern"

Scott McNeil
Banstead, Surrey, UK
It is common for arguments to erupt between people over this issue. However, I feel duty bound to point out that, when it comes to the best method, there are actually three types of people: those who prefer the paper rolling towards them, those who prefer it to roll away and those who prefer it to roll towards them, but own a cat.

Keith Thomas
Faculty of health sciences and wellbeing, University of Sunderland, UK
While different views might be argued over the feng shui of toilet roll positioning, there is a more critical microbiological concern.

I suspect that hanging the free paper against the wall is likely to result in more extensive microbiological contamination of the wall surface, potentially leading to greater transmission to fingers in the future.

Surfaces of tissue dispensers in toilets have been found to harbour high levels of microbes – albeit less than toilet door handles.

Peter Borrows
Amersham, Buckinghamshire, UK
If the toilet paper is rolling towards you and you have an opposable thumb, you will be able to grip the paper without touching anything else.

If it is rolling away from you, it is almost certain that you will touch the wall. If the wall is painted, that would ultimately damage the paintwork. It is also likely that you would transfer to it some of whatever was on your fingers, including sweat, grease, bacteria and viruses. You might also pick up what was on previous users' fingers. That doesn't seem a good idea to me.

Stephen Head
Cholsey, Oxfordshire, UK
This is a controversial topic. The 1891 patent for the toilet paper roll by Seth Wheeler of Albany, New York, shows the end of the roll hanging towards the viewer.

Some say this is more hygienic, avoiding contaminated fingers touching the wall, while others claim that dominant personalities hang the roll this way.

I have even heard it suggested that men and women take different views. To avoid marital discord, in our house, the roll sits vertically on a charming old darning mushroom, sidestepping the whole debate.

***@sempir**, via Twitter*
Ours stands vertically and rolls left or right, depending on who replaced it!

***@Ozildelusagnan**, via Twitter*
Best is no toilet paper, use a bidet.

Yawning gap

Is it possible to yawn without closing your eyes? If not, why?

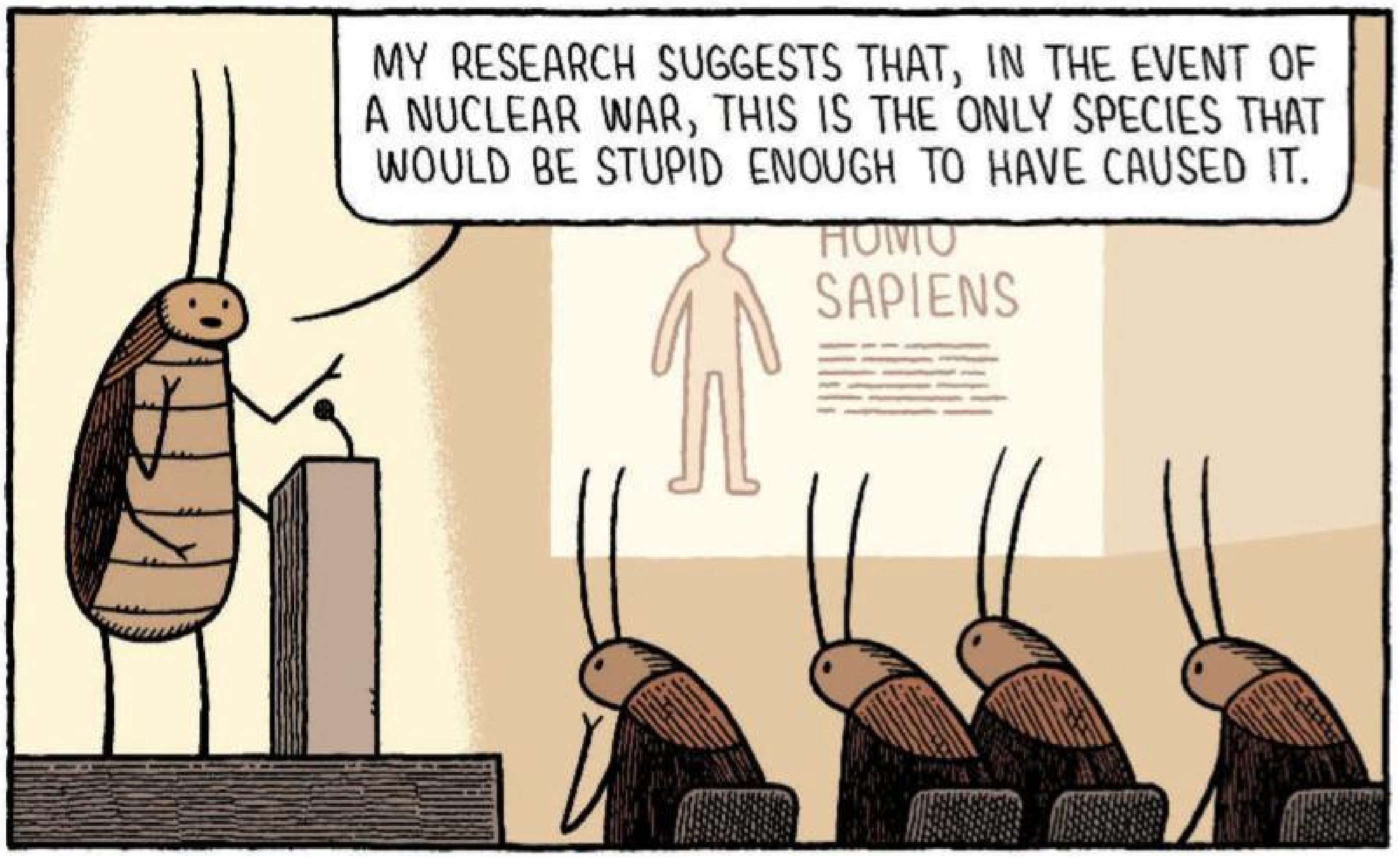
Garry Trethewey
Cherryville, South Australia
I have kept my eyes open while I yawned in situations when my mind wandered during a boring conversation, but some small part of me remembered to be respectful and maintain eye contact. It is an effort though.

Cherry Boa
London, UK
Yes, it is possible to yawn with your eyes open if you consciously resist closing them. The tendency to close the eyes is because you get a "better" yawn if you let the facial muscles relax into it.

As a psychotherapist, some narcissistic patients elicit a need to yawn. This obviously isn't therapeutic, so I try to resist. That can only be done by controlling muscles around the mouth primarily, but also those around the eyes. A good

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Tom Gauld
for New Scientist



yawn requires totally letting them relax.

***Nicholas Howden**, via Facebook*
Yes it is. I just did it. But I had to fight the reflex to blink, as yawning makes my eyes water, which triggers blinking.

***@ProfeGreg**, via Twitter*
Yes, but it is so much more satisfying with your eyes closed.

Gillian Forrester
University of Sussex, UK
Yawning is something of a mystery. In 1986, Robert Provine, a pioneer of yawning research, wrote that "yawning may have the dubious distinction of being the least understood, common human behavior".

When we yawn, we tend to close our eyes, but we can override this – when driving, for example. Perhaps we can gain some insight by looking at the yawning behaviour of primates.

Primates yawn for two reasons: tiredness or because they feel stressed or vulnerable. Their eyes close when they yawn due to tiredness, but stay open during a stress-related yawn. So, it makes sense that we can also control what happens to our eyes when we yawn. Maybe we, too, yawn for different reasons, and when we find ourselves yawning in a physically or socially challenging situation, we keep our eyes wide open, regardless of how tired we might be.

"It is possible to yawn with your eyes open if you consciously resist. But you get a 'better' yawn if you let facial muscles relax into it"

***@Grammar_dammit**, via Twitter*
Lots of people yawn without closing their eyes. It is sneezing with your eyes open that is near impossible.

***@bleetin**, via Twitter*
Is it possible to sneeze and yawn at the same time?
WE NEED ANSWERS!

Other universes

How could I theoretically reach other dimensions in the multiverse if they exist? (continued)

Peter Bowman
Banksia Beach, Queensland, Australia
In view of the success of Douglas Adams's Infinite Improbability Drive, which allows instant access to all points of his universe, it seems to me that a little tweaking could produce a Totally Impossible Drive, which would provide access to other universes.

Edward Figaredo
California, US
A previous response (28 January) stated that physicist Paul Dirac would condemn this sort of theorising as "not even wrong". Perhaps Dirac used these words, but the phrase originated with Wolfgang Pauli, and in his native German was "Das ist nicht nur nicht richtig; es ist nicht einmal falsch!", meaning "that is not only not right; it is not even wrong". ▮

Answers

Quick quiz #194
Answers

1 A zygote
2 *Homo ergaster*
3 Jöns Jacob Berzelius
4 17 (2+3+5+7)
5 Gravitational lensing

Cryptic crossword #105 *Answers*

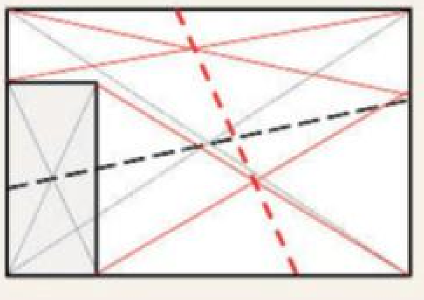
ACROSS 1 Pica, **3** Nuthatch, **9** Loupe, **10** Devices, **11** Obscure, **12** Atom, **14** Enlace, **16** Pollux, **19** Used, **21** Orbiter, **24** Caravan, **25** Aloud, **26** Roof rack, **27** Gnus

DOWN 1 Pullover, **2** Counsel, **4** Undoes, **5** Have a go, **6** Tycho, **7** Hess, **8** Peru, **13** Extrudes, **15** Cadaver, **17** Letdown, **18** Cognac, **20** Servo, **22** Bear, **23** Scar

#213 Cross sward
Solution

The red dashed line halves the lawn, leaving the vegetable plot intact; the black dashed line halves the lawn and the plot.

Any straight line going through the centre of a rectangle will divide it in half, whatever the line's angle, so the lawn can be halved by splitting it into two rectangles, then drawing a line joining their centres. If the partition passes through the centre of the garden and the centre of the plot, the plot and the whole garden will be split exactly in half. If this is the case, it follows that the lawn must also be split into two equal areas.



Arachnonecrocapitalism

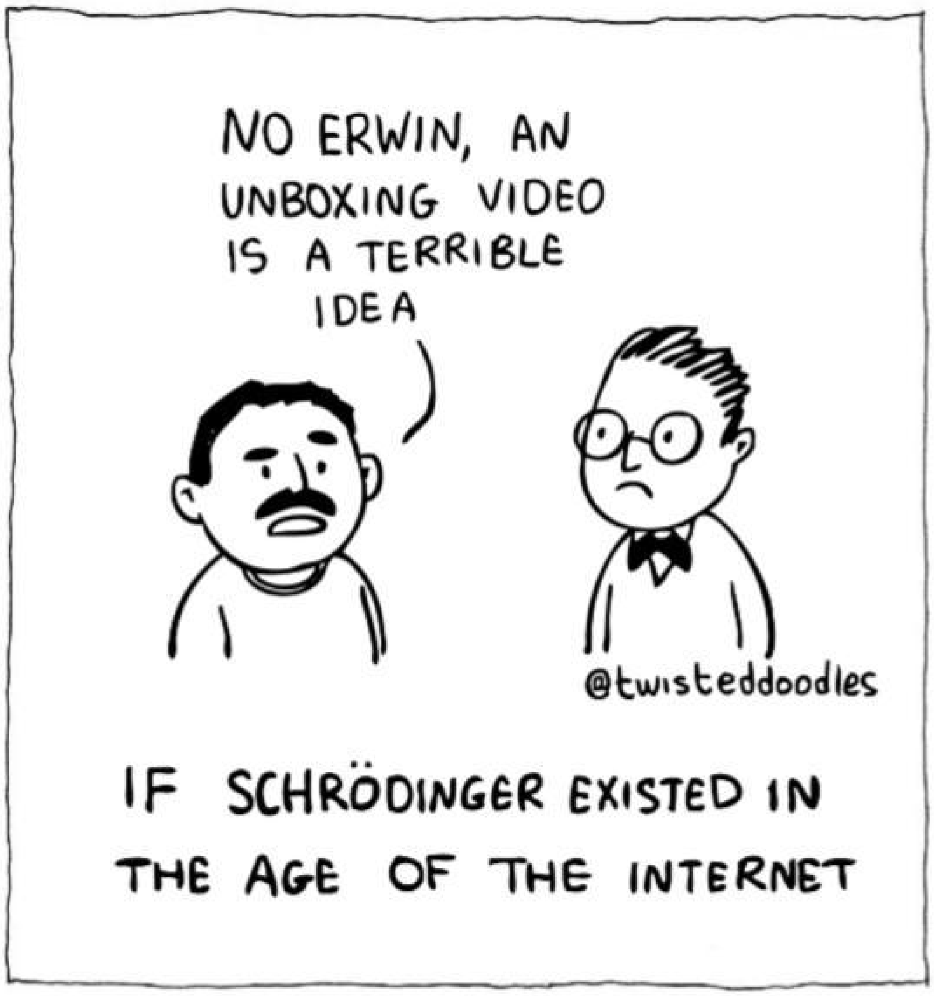
The death of a spider in Texas has led to the birth of a philosophical movement, with Rice at both ends.

This life-and-death saga began with a recent, almost instantly famous experiment at Rice University in Houston, Texas. A team of mechanical engineers converted a dead spider into a robotic, pneumatically actuated gripper tool. The inventors describe it as "a ready-to-use actuator requiring only a single facile fabrication step, initiating the area of 'necrobotics' in which biotic materials are used as robotic components".

This news gripped and animated Stian Rice at the University of Maryland, Baltimore County. Rice and James Tyner at Kent State University, Ohio, published a paper in the journal *Human Geography* called "Along came a spider… and capitalism killed it". Rice and Tyner decry the prospect of what they call "procedures designed to convert death into useful, productive labor". Such things, they warn, "portend a deepening of necrocapitalism and the violence of science".

They issue a horror-fuelled plea to all humans: "We view the necrobotic spider as an omen, one that calls us to refigure our understanding of violence in a post-humanist and post-anthropocentric way."

Twisteddoodles *for New Scientist*



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Consideration of items sent in the post will be delayed

A little on the nose

There has been uncertainty about whether changing climate, over the very long haul, has affected the shape of the human nose, Ted Schark informs Feedback. This is why researchers at Pennsylvania State University, the University of Illinois, Trinity College Dublin in Ireland and KU Leuven in Belgium have looked into the matter. Their answer: yes, kinda, sorta.

The researchers compared the noses of people whose ancestors are believed – from genetic analyses – to have come from disparate parts of the globe. These regions have historically had very different kinds of climate. "We conclude that some aspects of nose shape may indeed have been driven by local adaptation to climate," they write in a deadpan, not-very-thriller report titled "Investigating the case of human nose shape and climate adaptation".

"However, we think that this is a simplified explanation of a very complex evolutionary history, which possibly also involved other non-neutral forces such as sexual selection."

Taking sides

Go left or go right? Sheryl Bourgaize and Michael Cinelli at Wilfrid Laurier University and Bradford McFadyen at Laval University, all in Canada, addressed that choice face on in a series of forced encounters. They asked the specific question "How do people avoid a collision to the left-side or right-side of a single stationary pedestrian (interferer) of varying shoulder width and orientation?"

The trio set up a series of encounters, asking volunteers to walk down a path on which they would encounter an obstacle. The obstable was human. They engineered the situation to explore different combinations of dodging to the left and right, as well as different shoulder widths. Sometimes a volunteer would be instructed to avoid the interferer's left side, sometimes to avoid their right side. Sometimes the interferer would face the volunteer, but at other times they would face backwards or to the left or right. Sometimes the interferer would be wearing bulky American football shoulder pads, sometimes not.

An optomechanical system recorded where and how each volunteer moved as they avoided the interferer. The report uses a fun, staid technical phrase to describe that movement: "trunk kinematics".

Bourgaize and her colleagues tried to be fair to both sides, arranging equal numbers of avoidances to the left and right. They discovered that the volunteers would usually pass closer to a human obstacle "when instructed to pass on the left" and that it made little difference which way the interferer was facing, or if they had bulked-up shoulders. This all happened in Canada. The researchers make no guarantee that it occurs identically elsewhere.

Trivial superpowers

Some people possess one or another trivial superpower, an ability to reliably do some particular task that – to them – seems mundane. Others persistently fail at this task, except once in a while by sheer luck.

Here is an example. Glance at a container that is only partly full of some flowy substance – sugar, flour, juice or whatever – and you might instantly know (know, not guess!) whether that amount of glop will or won't fit into a container of a particular different shape and size. Some people can do that. Most can't.

Feedback will try to do the possibly impossible: compile a complete list of these trivial superpowers. Do you know – either because you yourself have it or because you have directly witnessed someone who has it – of some other trivial superpower? If so, we would love to hear about it. Please give a clear, short description of the ability. We will select some of the best and describe them here in Feedback. Send your entry by post to "Trivial Superpowers", c/o Feedback, to the address on this page, or by email to feedback@newscientist.com.

Please apply your superpower of selecting a skill so very unusual – and so very mundane – that most people will scarcely believe that any human has it. ▮
Marc Abrahams

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